AMERICAN MACHINIST

A PRACTICAL JOURNAL OF MACHINE CONSTRUCTION

VOLUME 23 — NEW YORK AND LONDON — NUMBER 44

Published at 218 William St., New York,
Every Thursday by the

American Machinist Press.

[INCORPORATED.]

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A. LEIGHTON DONNELL, Sec'y.

Also published at 34 Norfolk St., Strand, London, W. C.,
Every Saturday.

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Correspondence on mechanical subjects solicited. Name and address must always be given—not necessarily for publication.

Address all business communications to the American Machinist Press. Matter for reading columns may be addressed to the Editor.

Subscribers can have address changed at will. Give old and new addresses. Date on wrapper denotes end of month in which subscription expires.

Subscription Price:

$3 per year in advance, postage paid, in North America.
$4 per year in foreign countries, postage prepaid.
No back numbers beyond current year.
For sale by newsdealers, generally.

AMERICAN MACHINIST CO., Ltd.,
34 Norfolk St., Strand, London, W. C.

ADPHE. JANSSENS, Ingr.,
16 Place de la République, Paris.
10 A Boulevard Barthélemy, Bruxelles.

V. LOWENER,
Copenhagen,
Representative for Denmark, Norway and Sweden.

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Neue Promenade 4, Berlin,
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Puertaferrisa, 7-9 Barcelona,
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Entered at New York P. O. as second-class mail matter.

Cable address, "MACHINIST," N. Y.
Lieber's and A B C Codes.

Settlement of the Coal Miners' Strike

At this writing the coal miners' strike seems to be settled by a practically complete victory of the men, and it is being assumed by some of our contemporaries that their victory proves that their demands were just. We cannot agree with this interpretation of it. The forces which have justice and right on their side do not always win victories, but are perhaps most often defeated. This is not to say that the men were not right, but simply that their victory does not prove either that they were or were not. The operators have put themselves in a somewhat ludicrous light by granting concessions which they at first vowed they never would and could not grant and by attempted defenses of practices for which there was no defense and that they attempted to maintain for no other reason whatever except that the coal combine made money out of them. We note that the "Iron Age" now advises operators to refrain from discussing such matters in future and to maintain a "dignified reticence," saying that "The public was not in any sense a party to the controversy and could do nothing to decide it." Possibly, however, it was a more or less clear recognition of the fact that the public was a party to the controversy affecting its supplies of coal that impelled the operators to attempt a defense and explanation. It is proper in most cases probably for an employer to abstain from discussing matters of this nature where the work and business is of a private nature and where the general public suffers no inconvenience or hardship from its temporary or even its permanent stoppage. But where the work done or the business conducted is of a public nature such as the supplying of fuel (especially where, as in this case there is a monopoly of it), or in furnishing public transportation, a policy of "dignified reticence" would inevitably be understood as an exemplification of the old Vanderbilt principle of "the public be damned," and the day for that sort of thing has mostly gone by.

In our view one of the most sinister aspects of this disturbance is in the rumors or rather charges that politics have had a great deal to do with the inauguration of the strike and with its settlement. We do not know how much truth there may be in this, and place precious little confidence in the sources from which most of the reports emanate. But we can scarcely imagine anything worse or more likely to injure and impede our industrial development as well as to corrupt and debauch our people politically than to have it become a practice to start strikes with reference to political effect and to have them settled with the same reference instead of upon their merits or in accordance with the real conditions affecting the business.

Report of Admiral Melville.

The annual report of Admiral George W. Melville, Chief of the Bureau of Steam Engineering, recently forwarded to the Secretary of the Navy, is, as it could not have failed to be, an ably written and highly interesting paper. We can spare space only to notice a few of the most important points touched upon.

The paper opens with a plea for appropriations adequate for maintaining the work of the bureau, so that it may be most efficient, and not incomparable with the other nations of the world, pointing out the activities of all the powers and the lavish expenditures not only in repairs and maintenance, but also in the building of new ships, and especially in conducting elaborate and extensive experimental work in the various fields of investigation. The necessity of building and maintaining repair ships is especially insisted upon, the work of the hastily improvised "Vulcan" in the Spanish War having amply demonstrated the value of such adjuncts to fleets engaged in the actual operations of war. An appropriation is asked for a new ship throughout of at least 5,000 tons displacement and to cost about $1,000,000, which, by the way, would only be about one-quarter of the cost of a first-class battleship.

The improvements under way at the shops and machinery plants at the various navy yards come naturally next in the report. There has been delay in placing contracts for new buildings on account of the high price of material, and changes have had to be made in designs to keep within the appropriations. Great care has been taken to make all new buildings absolutely fireproof. Contracts have been made for the power plant of the new shop at the New York navy yard, and also for the power tools.

In the preparation of specifications for tools, care was exercised to avoid calling for patented and proprietary articles which could be supplied only by individual firms, and the success of the scheme was evidenced by the great numbers and the wide range of the bids received, and a selection of first-class tools was made at reasonable prices. An extensive and fully equipped plant is called for in the Philippines, either at Cavité or at some more suitable point.

An appropriation of $100,000 is asked for experimental work. Immense sums are expended annually by other powers, and the results obtained lead to the avoidance of costly errors in practice, and to higher efficiencies in succeeding designs. The unsatisfactoriness of experiments made with models is sufficiently familiar. The bureau needs reliable data on the economy of engines running at a small fraction of their maximum power, and this information is to be obtained only from a modern and fully equipped vessel. The economy of the boiler, of the main engine and the various auxiliaries could be obtained for various speeds, and the data thus obtained would suggest changes

for the better in all subsequent practice. The "Raleigh" or "The "Cincinnati" is suggested as a suitable vessel, which could at the same time be a practice vessel for the Naval Academy.

The use of liquid fuel has not been demonstrated to be more desirable than that of coal, either here or abroad. Suggestions are made towards the imposing upon contractors for new ships of requirements for economy tests whereby the machinery at maximum and other selected powers must show certain horse powers at stipulated costs for coal. This is insisted upon by other powers, but, as with us detailed plans are examined and approved, such requirements have seemed to be scarcely just.

The report strongly opposes the consolidation of the Bureaus of Construction and Repair and of Steam Engineering and Equipment into one Bureau of Ships, as proposed by the Secretary of the Navy a year ago. "Every tendency is to increase specialization in work, owing to the ascertained value of a system whereby leading talent in each department may devote itself to the advancement of its particular branch, and not be diverted therefrom through a maze of miscellaneous and unrelated work." The next paragraph which we reproduce is full of the personality of the author.

"That differences should agitate the board is not only natural, but also highly proper, and is a most effective protection against hasty and regrettable action. This occasional lack of harmony must not be confused with any real lack of efficiency, nor into a cause for recommendations having for their object the reversal of the true business principles by a combination of radically different professional duties. Not only would such a course fail to bring harmony, but a surer result would be in a speedy decline in the rate of progress made in each profession. I, in common with the chiefs of other bureaus, naturally feel a pride in the eminence of the bureau I control, but I am honest in declaring that my opposition to the proposed combination has a reason far above personal feeling or ambition, and that reason is my positive knowledge of the fallacy of the arguments for it and the firm conviction that only confusion, greatly decreased efficiency and greatly increased expense can possibly result."

A most regrettable thing is the necessity which exists for the report to go again into a discussion of the personnel question. The effect of the law after two years of trial, the report states, has been very unsatisfactory to the steam engineering interest of the navy. The work of the bureau has greatly increased while the number of skilled officers available for the work has decidedly decreased. The cause lies not so much in the law itself as in the failure of the department to encourage officers to take up this line of work. The concluding portion of the report is a most earnest appeal for efficient engineer officers in sufficient numbers, and most serious consequences are predicted if prompt steps are not taken to materially increase the present staff. Admiral Melville says:

"Inattention to my recommendations or apathy regarding the immediateness of the necessity for more active and decided measures toward securing the desired conditions can surely result in nothing but rapidly decreasing efficiency, from which it will be continually more difficult to recover, and the cost of which will be significant in enormously larger repair bills, shorter-lived machinery, and a fleet of vessels in doubtful fitness for their designed service—a Cervera fleet, with limitless men, but lacking the technical experts needed to meet the extraordinary and ever new conditions of emergency and war.

"I regret I have failed to impress you to the point of action by my former communications. Had a series of calamitous events occurred during the past year to make graphic the insufficiency of the present force of expert engineers, I am sure potent remedial measures would have been promptly taken by the Department. But while glad indeed to have disasters averted, I can assure you that danger now exists. It lurks in the silence of seeming security, but a knowledge of its presence should increase the desire to hasten its removal. Fortune alone has postponed casualty.

"The country can safely count on the valor and fidelity of its officers and men, but fidelity and valor without knowledge of the use of the arms given them with which to do battle can avail little against an efficiently drilled foe, and will scarcely afford more than an exhibition of heroic sacrifice, as needless as it would be cruel. The arms of a battleship are her machinery and her guns, 'useless each without the other,' and strong to victory when working well together. No deep thought is necessary to understand this, in the light of late experience. The very highest degree of excellence in both the condition and handling of each is the price of successful encounter, or at least is the expectation of the country. A ship motionless or helpless to maneuver well could never make efficient battle, be her guns ever so good or her crew ever so brave. To guard against this the head of the Steam Engineering Department must be full of resource and armed by experience and engineering ability only attained by years of intimate association with machinery under all conditions of service. Haphazard luck may bring a ship through without this, but sane judment would condemn dependence on simple fortune or a failure to use every possible effort to insure a most competent management in this most important of ships' departments."

The admiral would, by departmental order, compel all line officers below the navigators of ships to alternate in duty in the engine room and on deck, and would have efficiency reports made quarterly to note their progress and to class their ability.

Personal.

Frederick D. Herbert, M. E., has removed to the St. Paul building, 220 Broadway, N. Y., where he has opened offices with James Brady, M. E., and will carry on mechanical and marine engineering.

F. Orton, who was formerly located in San Francisco and for some time past has been with George Richards in London and Brussels, has taken a position in the drafting room of the E. W. Bliss Company, Brooklyn.

Obituary.

C. O. Lindroth died at Johnstown, Pa., October 18, forty-seven years old. He was for fifteen years mechanical engineer of the Southwark Foundry and Machine Company, of Philadelphia, and recently had been in the employ of the Cambria Steel Company in the same capacity.

William Hickman Tasker, the eldest son of the late Thomas E. Tasker, one of the founders of the firm of Messrs. Morris, Tasker & Co., died in Philadelphia, October 24, seventy-nine years old. He was connected with the pipe works of the company until the plant was removed to New Castle, Pa., fifteen years ago.

George W. Hamilton, a veteran mechanic, died in Brooklyn, October 22, eighty-four years old. Mr. Hamilton was a native of Scotland and came to this country when a boy. He began work at the Phenix Foundry in New York City in 1832. He formed the Ritchey & Hamilton Foundry Company in Brooklyn, leaving in 1857 to go to Minnesota. He returned to Brooklyn in 1862 and was engaged in the manufacture of stair rods until two years ago.

An Automobile Show.

An automobile show will be held in Washington, D. C., during the week of December 10. It will be known as the National Automobile and Sportsman's Exhibition, and will be held in Convention Hall, with a floor space of 36,000 square feet. This show is to be given under the direction of a number of prominent Washington business men. The manager is Edward Reynolds, New York avenue and Fourteenth street, N. W.

The American Window Glass Company, Pittsburgh, has put in trust for the Window Glass Workers' Association, 5,000 shares of common stock, to be delivered when accumulated dividends have paid for it, and will give the association representation in the board of directors. President Simon Burns, of Local Assembly Knights of Labor, 300, is expected to fill the place.

Commercial Review.

NEW YORK, Saturday, October 27.

THE TOOL MARKET.

Evidences of a strong undertone to business are easily found. Trade is not heavy, but there is a sufficient inquiry to raise hope that it will be after election. In some cases that event is being anticipated by an immediate closing of orders. One of the unfavorable reports that recently has reached us is a condition of decided quietness among lathe manufacturers in Worcester, Mass. But on the other hand a number of local selling houses talk of improvement. On the whole the outlook may be pronounced bright and gratifying.

The Arthur Company, New York, reports a very large increase of business in its gear-cutting department. It has added to its cutting plant two more seven-foot spur gear cutters within the last eight months, and has just completed a large helical and worm-gear cutting machine of its own design which cuts spiral or helical gears and worms up to 6 feet in diameter, any angle or ratio.

The Perkins Machine Tool Shop, Lowell, Mass., is to be sold at auction at 11 o'clock, November 1, by J. E. Conant & Co., auctioneers of that place. The sale is rendered necessary by the death of the proprietor, F. S. Perkins. The shop will be continued in operation up to the day of sale, filling orders. The employing capacity of the works is 75 men; product, engine lathes, 15 to 40 inch swing, speed lathes, 10 to 22 inch swing; half-automatic rack cutters, and special wood and iron-working machinery. The real estate is sold as one lot, machinery in lots to suit purchasers.

The Hoopes & Townsend Company, of Philadelphia, Pa., have contracted with the American Bridge Company to build a bar mill building 70x500 feet on the line of the Trenton cut-off of the Pennsylvania Railroad.

One of the most interesting enterprises now on the carpet from the tool builder's standpoint is the new $1,000,000 plant of the Singer Sewing Machine Company, at South Bend, Ind. The building contract has been given to James Stewart & Co., St. Louis. There will be a machinery building, 60x840 feet, four stories high; a finishing and shipping department, 60x600 feet, four stories; a cabinet and veneering department, 60x600 feet, four stories; two boiler and two engine rooms, of one 25-foot story, each 45x196 feet; a one-story veneer drying building, 60x200 feet; three one-story lumber storage buildings, each 124x200 feet; a one-story veneer storage shed, 80x200 feet; two one-story pump houses, each 20x60 feet, and a two-and-one-half story office, about 75x80 feet.

The Stirling Company, Chicago, manufacturer of water-tube boilers, contemplates doubling the size of its plant at Barberton, Ohio, after election. Over 600 men are now employed. Present orders are sufficient to warrant the increase, only many are conditional on the results of election.

AN INTERVIEW ON THE EUROPEAN TOOL MARKET.

One of the latest arrivals from Europe is H. B. Binsse, of the Newark Machine Tool Works. In conversation with a representative of this paper, Mr. Binsse expressed his views upon the situation in Europe, particularly in Germany. To begin with, he corroborates what has already been said, that there is a marked depression in the tool trade. This is especially notable in small machine tools. The slump is attributable to the creation of so many new manufacturing enterprises that it has resulted in an overproduction. Machinery of all sorts is susceptible to the reaction, though machine tools are among the earliest lines to be affected. Although this depression exists in Germany and Russia and no doubt other Continental countries, Mr. Binsse is very decided to the effect that England is not to be put into the same category, nor does he think that France or Belgium deserve to be. The English demand is destined to be a good one, he holds, although there may not be quite the volume that there formerly was, owing in part to the fact that buyers are becoming more critical of the tools offered them.

But the view taken of the field centering in Germany is by no means a discouraging one. He does not advise tool manufacturers to retire from the contest, although they may perhaps lie low for a while. He looks for the adverse business conditions to pass over within a reasonable length of time. He advises those who wish to push foreign trade to give increased attention to certain of their methods.

First, they should come into closer relations with the consumer. Since there are so many German-made imitations of American tools they are likely to be accepted by purchasers instead of the originals, unless it be made clear that the originals are superior. To demonstrate the greater merits of the American-made tools the manufacturer should bring directly to bear more special technical knowledge and persuasion than is to be expected from selling agencies handling many brands of machines. He ought therefore to do this missionary work for himself whether he is represented by a dealer or not. As to the question whether the German-built tools are in fact inferior to the American Mr. Binsse states that in almost all cases he has found them so. He saw a few German milling machines, however, which seemed almost, if not quite, equal to the best American ones.

Secondly, in addressing foreign buyers with literature in their vernacular, it is important to use utmost pains to give the technical terms correctly. We have already said so much in these columns about the necessity of printing catalogs in a language that the buyer understands and printing them correctly that we are almost ashamed to bring up the subject again. But Mr. Binsse seems to regard this as one of the great lessons yet to be learned. He tells a little Paris Exposition story which may serve to press home the moral. While at Vincennes, talking with an American tool manufacturer who had some tools on exhibition, their attention was drawn to the inscription placarded upon a booth not far away from his. Mr. Binsse observed that it was worded in an absurd attempt at the French language. "I have been wondering for a long time what was peculiar about that booth," remarked his friend. "One sees so many groups of people collecting to look at it. A Frenchman will pause and gaze and then he will go and bring some other Frenchman and they will both stand there and stare and laugh."

Mr. Binsse has a copy of a catalog of an American tool specialty printed in German and executed with considerable pains to make an attractive pamphlet. But the renderings of the mechanical terms display so much originality that the German house representing the manufacturer wrote back that it was out of the question to make use of the catalog. The very name of the appliance to which the publication relates is rendered a monstrosity. The translation was made, no doubt, by some German-American who had been reared upon the language of the Fatherland but who had steadily been forgetting it since he landed at Castle Garden, and was not up-to-date in technical terms as expressed in his native tongue. An expert knowledge is requisite for such work as this. To give the literal equivalents of the several American words does not necessarily reproduce the meaning of the expressions as a whole. Mr. Binsse remarks that it is especially important to be correct when using the French language, because in France so much stress is laid upon elegant speech and so many judgments are based upon that ground. Frenchmen receiving from an American manufacturer an ungrammatical circular are led to regard him him as some sort of charlatan. They are inclined to think of Americans as a race of P. T. Barnums, anyway.

A few other points of interest were developed in talking with Mr. Binsse. He remarked that Russian trade has been the result of artificial stimulation more than has the German. The enterprises of the Russian Government have forced a demand for machinery. It is therefore questionable what staying or recuperative powers this trade will prove itself to possess. Speaking of the German market he admitted that although it is in such a bad way as far as the sale of smaller standard tools is concerned, there is some demand for heavier ones, including turret machinery. The business atmosphere will gradually grow clearer, he thinks, through the partial dying out of the competition of new

German tool builders. These people were induced to enter the field by the high cost of American tools, which was largely owing, he says, to the big percentages made by importers. At the rate at which machine tools were then selling, almost anybody in Germany could turn to and manufacture them at a profit. But now that native competition has grown so enormously they will find it quite another matter.

Mr. Binsse is confident of the future of our German tool trade so long as we keep making progress. We cannot continue to sell any great number of the same standard tools indefinitely, but as new and improved ones are brought out they will find a market.

PITTSBURGH REPORT.

Transactions in the iron and steel trade during the past week or two have placed the market in a pretty healthy condition, but this is thought to be only temporary, as a good movement in all branches of the industry is hardly to be expected until the month of November is past the middle mark. By some it is thought to be preliminary to an improvement that will be established permanently so soon as the political clouds have disappeared and the air has become clearer.

The Pittsburgh district generally experiences the first symptoms of anything in the nature of an improvement. The willingness of many of the producers to bring prices down to almost cost has brought many purchasers to this center. Nearly all lines show more or less improvement, except pig iron, which shows very little life. In conversation with one of the leading pig-iron selling merchants a few days ago, the fact was brought out that where sales of 1,500 to 2,000 tons were formerly wont to be made, the delivery to be extended over a period of three months, the present custom is to order about 200 to 300 tons and have shipment made at once. It is the hand-to-mouth plan nowadays instead of the long-delivery system. A sale of 1,000 tons of No. 2 foundry was made by a Southern firm at Richmond, Ind., at $10.50 a ton, furnace, the price being lower than that asked by Northern concerns. Stocks of iron are large, the figures showing over 600,000 tons in the yards, which amount is greatly in excess of the requirements. In finished lines there is a fair amount of business doing and mills are moderately busy. Some of the larger Pittsburgh concerns are shipping considerable quantities of billets, structural steel, etc., to European ports.

Prices are still below what they should be, but in some cases sellers are refusing to meet some of the prices quoted a month ago. No. 1 foundry is placed at $14.50; No. 2 at $14.25, and No. 3 at $13.75.

CHICAGO MACHINERY MARKET.

The most interesting feature of the Western machinery trade is the bids to be opened on next Tuesday, October 30, for a large amount of machinery for the Rock Island Arsenal, largely small machines to be used in the construction of Krag-Jorgensens. All machinery men out this way are bidding, but it is anticipated that the contracts will not be let for a considerable time. Comparatively little business has been closed in machinery during October. One of the good orders was that of the Toledo (O.) Bridge Company, estimated to be about $18,000, the contracts for the machines being well distributed. Another fairly good order was that of the Goodman Manufacturing Company, Chicago, which succeeds the coal-mining machinery department of the Link Belt Engineering Company, their order probably reaching $12,000. McDowell, Stocker & Co. closed two orders for new outfits, one aggregating $5,000 for a new paper-cutting and printing-machine manufacturer at Chicago and the other for $2,000 with a prospective builder of contractors' machinery at Joliet, Ill. An order received by the Marshall & Huschart Machinery Company amounted to $14,000.

A seller of both machines and small tools remarks that the demand for the latter is comparatively much better than that for the former. As the result of many inquiries, it may be said that trade in machine tools during October will scarcely average as well as September, but it is quite commonly remarked that the month is going out much better in point of activity than it was ushered in. A significant fact is that inquiries are universally pronounced good. The statement is also made that users are buying only what they have to. Machine-shop activities are generally fairly good and perhaps improving but it is not common to hear of shops running overtime.

An exception is in the line of mining machinery. It is reported that shipments on some very heavy orders for South Africa, taken before the late South African war and suspended, have been resumed. The Fraser & Chalmers plant in this city is running overtime and an excellent demand is reported not only from abroad but from the mining regions of the West. In Montana and some parts of Utah the people are too busy just now trying to "save the country" to give much attention to the buying of machinery, but the prospects are for a heavy trade later.

The Q. & C. Company reports inquiries during the past two weeks to be much more numerous than for some time, and while actual buying is not correspondingly good, many orders have been held up that will probably be given later.

Woodworking machinery is perhaps faring better in this locality than iron-working machinery. The American Woodworking Machinery Company says orders have notably increased in October over September. Several new outfits for local shops have been sold, and the South is an active buyer.

CINCINNATI REPORT.

Relatively speaking, there has been little or no change in the last four or five weeks in the local machine tool trade. With the price of material, however, so much may not be said, and a prominent local representative of a big steel manufacturing combination to-day affirmed that there are no orders being taken for future delivery and that the wise manufacturer is ordering now. The phenomenal demand for power machinery continues and the electrical concerns making this class of work are having their handsfull.

The Lane & Bodley Company, making engines, report demand good on orders, principally of the smaller class and the majority from the South for running cotton-mill machinery. One order is from the Humboldt Cotton Mills, of Humboldt, Tenn., of 750 horse-power capacity. The Lane & Bodley Company reports prospects exceedingly good with prices well maintained.

The plant of the American Rolling Mill Company, at Middletown, Ohio, an outgrowth of the American Steel Roofing Company, having interests in Cincinnati and elsewhere, is rapidly nearing completion. Officials confidently expect to be turning our sheet metal some time in December or early in the new year. President Geo. M. Verity and Secretary R. C. Phillips alternate between the Cincinnati and Middletown establishments and are exceedingly busy these days.

Quotations.

NEW YORK, Monday Oct. 29, 1900.

Iron—American Pig, tidewater delivery:—

Pennsylvania Irons:

No. 1 X foundry	$15 75	@$16 50
No. 2 X foundry	15 00	@ 15 50
No. 2 plain	14 25	@ 14 75

Alabama Irons:

No. 1 foundry, or soft	15 25	@ 15 75
No. 2 foundry, or soft	14 25	@ 14 75
No. 3 foundry	13 25	@ 14 25

Bar Iron—Base sizes—For good refined brands on dock, 1.40 @ 1.50c., and for same from store 1.65 @ 1.75c.

Tool Steel—Base sizes—Good standard quality, 7 @ 8c.; extra grades, 10 @ 14c.; special grades, 16c. and upward.

Machinery Steel — Base sizes — From store, 1.60c.

Cold Rolled Steel Shafting—Base sizes—From store, 2½c., commonly.

Copper—Lake Superior, ingot, in carloads, 16¾c.; electrolytic, 16½ @ 16⅝c.; casting, 16⅜ @ 16½c.

Pig Tin—28¼c. for 5 and 10-ton lots, f. o. b.

Lead—For wholesale lots, 4⅜c., with .02½ @ .05c. extra for carloads.

Spelter—Prime Western, about 4.15c., New York delivery.

Antimony—Cookson's, 10½ @ 10¾c.; United States, 9⅛ @ 9.35c.; Hallett's, 9⅛ @ 9¼c., according to quantity.

Lard Oil—Prime City, 58c., in barrel lots.

A New System for the Manufacture of Steel Balls.

It rarely happens in our industrial life that a practical art of such importance to the mechanical world as that of manufacturing steel balls, rises silently to almost ideal perfection in a few years, leaving the majority of even advanced mechanics ignorant of the steps taken or the processes and machines finally surviving the experimental stages of development. Ask twenty mechanics, outside the readers of this journal, how steel balls are made. One may have a vague idea that they are "ground." The nineteen would have no idea at all. The general lack of information about ball manufacture is doubtless due to the comparatively recent adoption of ball bearings for machinery, and to the fact that very few methods are obviously applicable to the production of truly spherical and uniform bodies.

The purpose of this article is to describe what are probably the latest and most radical system and machinery for producing balls of any required degree of accuracy of form and size. The system and machinery referred to are those employed by the Steel Ball Company, of Chicago, and were devised by Mr. C. C. Hill, vice-president and general manager of the company, who was an occasional contributor to this paper in earlier times.

It may be stated at the outset that the methods and machines devised by Mr. Hill are at every step radically different from systems heretofore used, and constitute a chain in which nearly every link is new. In all other systems used for making steel balls, so far as we know, the blanks are either forged under power hammers, turned in automatic screw machines, swaged in upsetting machines or rolled from straight rods, heated in furnaces and fed to rolling machines. The practice at the works of The Steel Ball Company consists, first, in cutting short cylindrical pieces from the coil or rod of steel, and passing them in bulk automatically through heating furnaces into forging machines, which by a combined forging and rolling action work them into spherical form ready for grinding. The economy of this method of making forgings for balls may be understood from the fact that no metal is wasted in the cutting machines, and that practically all blanks make perfect forgings.

The normal capacity of each of the cutting machines ranges from 300,000 to 700,000 per day of ten hours, according to the size of wire cut. The forging machines have still greater capacity, as they receive the blanks in regular streams from revolving muffles, heated by coke fires, and their output is practically limited only by the heating capacity of one pair of muffles for each machine.

The forgings are ready to be fed into the rough grinders as soon as they emerge from the forging machines and have had time to cool. The rough grinding is done on machines, each of which is furnished with one emery wheel, 16 inches diameter by 4 inches thick, having a central hole, 6 inches diameter. This wheel is cemented to an iron disk or face-plate, and grinds the balls in their passage through a semicircular path across its flat side. The forgings are fed to the machines by pouring a certain quantity into a hopper, while the machine is running, after which they circulate through the semicircular passage, in contact with the wheel, returning again and again to the hopper until sufficiently reduced in size, when they are switched into a suitable receptacle and a fresh supply poured in, no stopping of the machine being necessary.

After being rough ground, the balls are hardened by being automatically fed through revolving cast-iron muffles, from which they are dropped into a vertical tube, 8 feet long, suspended in a cistern of water, a strong upward current through the tube being maintained by a circulating pump; the tube being closed at the lower end by strong wire cloth, to retain the balls until the proper number has accumulated. After hardening, the balls are brought to the required temper by being heated to the desired degree, in a bath of oil and allowed to cool gradually. They are then ready for fine grinding. In fine grinding, the balls are again handled in bulk, being apportioned in batches of 2,500 ½-inch balls to 36,000 ⅛-inch balls (and other sizes in proportion), per grinder load, and they are so carried by the machine that balls can be taken out for gaging the process of the work, and replaced, as often as may be necessary, without stopping the machine.

Fig. 1 shows the principle of action of the cutting machines, which contain a steel cylinder, 6 inches diameter by 4 inches long, with six inserted blades or cutters, as in a milling cutter. Fig. 2 is a halftone of the machine. The teeth in revolving pass in close contact with a stationary cutter, and cut the wire or rod as it is fed forward by geared feed rolls. It will be noticed that the wire is fed at a considerable angle to the horizontal radius of the cylinder. This causes the wire to be cut obliquely across its axis, and thereby produces oblique ends on the blanks. This is absolutely necessary in order that the subsequent forging process may produce forgings free from hidden fissures or flakes. One other important feature in this machine is that the feed rolls and wire guide are made to travel back and forth the length of the cutters or cylinder, in obedience to a heart-cam, so that the wear on cutters is distributed progressively over their entire length, rendering it needless to sharpen the cutters oftener than once in two days. These machines are provided with extra interchangeable cutter-heads, to avoid delay in sharpening.

Fig. 3 shows bank of forging machines with furnaces and spouts, or conveyors, through which the heated blanks pass into the hoppers of the machines.

It will be seen that these machines are simple in construction. They consist mainly of a strong frame, carrying a vertical shaft, having a heavy flywheel and pulley mounted below the main plate, driven by a "mule belt" and carrying the forging tools above the plate. These tools consist of a cylindrical roll and a partial ring, or "concave," surrounding the roll. They are made from chilled iron, and have formed in their opposing faces semicircular grooves of slightly larger sectional radius than the forgings to be made. These grooves are deepened and enlarged at intervals of about four ball diameters, the enlargements being about two ball diameters in length, and cut slightly oblique to the plane of rotation of the cylinder. The ring or "concave" is firmly held down by clamps, and backed by strong set-screws. It is obvious that the grooves in these tools form together a passage of mainly circular cross-section, along which a ball of suitable size may be caused to pass. A small hopper is provided to partly fill up the interval between the ends of the partial ring, to receive the blanks from the

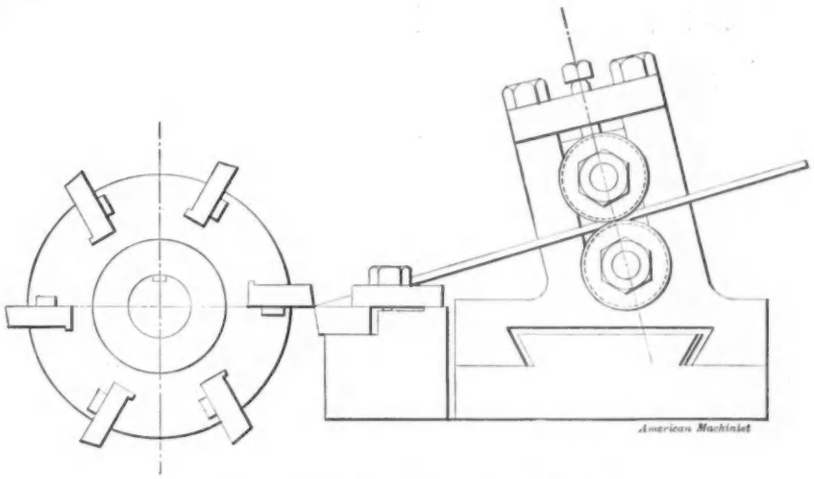


FIG. 1. ACTION OF THE CUTTING MACHINE.

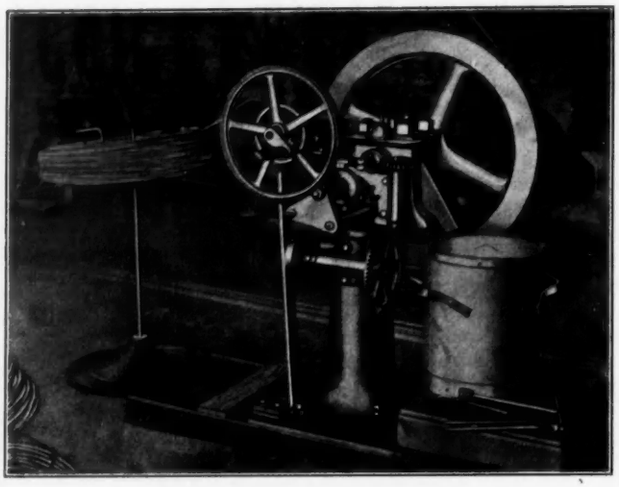


FIG. 2. THE CUTTING MACHINE.

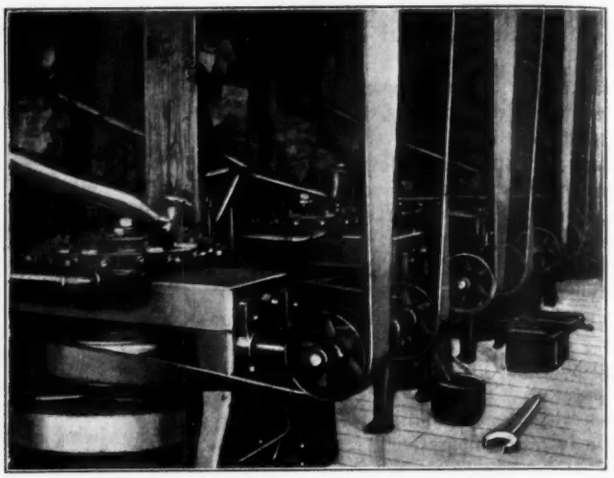


FIG. 3. A ROW OF FORGING MACHINES.

spout of the furnace and to lead them into the grooves between the roll and concave. The concave is set slightly eccentric to the roll, so that the blanks may enter the groove more readily, and be more gently acted upon for the first few inches of their passage.

The *modus operandi* of the forging process is as follows: Blanks properly heated fall from the furnaces and are conveyed by gravity to the hopper; there they are guided into the grooves, and as they fall into the depressions in the grooves, they are successively struck with a sort of glancing blow, and are rolled under pressure through the grooves until the next following depression is reached, when they are temporarily released, at the same time being given by the oblique depressions a slight angular twirl, by means of which they change their plane of rotation; these operations being repeated at each succeeding depression, until the balls in completed form are thrown out at the end of the passage. It will be readily understood that the forging done by these machines partakes more of a kneading action than of striking or rolling, the operation resembling more nearly modern hydraulic forging than hammer forging.

Fig. 4 gives a sectional view of the rough grinding machine, and Fig. 5 shows a set of them at work.

The machine consists mainly of a horizontal bed, having two spindles mounted parallel to each other, but "set over," in lathe-man's parlance, about three inches, so as to meet eccentrically, and having on their respective meeting ends substantial face-plates, accurately turned. Upon one of these face-plates is cemented the grinding-wheel, and upon the other is mounted a tempered steel ring—chilled iron for large balls. The ring is provided with a peripheral groove, as shown in Fig. 4, of V form, but with the inner wall parallel to the plane of the face-plate. Surrounding this ring at a suitable distance from it, is flexibly mounted a steel band of approximately square cross section, somewhat narrower than the diameter of the balls to be ground. This band is rigidly fastened at one end to a stationary rim surrounding the grooved steel ring, and so close to it that the inner surface of the band forms together with the V groove in the ring a "three-point" bearing in which the balls travel from the hopper across the emery wheel, returning then to the starting point. A series of flat steel springs retain the band in place and cause it to hold the balls firmly in the V groove, thereby insuring their continued gyrating motion while being ground. The ring revolves slowly, and rolls the balls against the band in a semi-circle across the wheel.

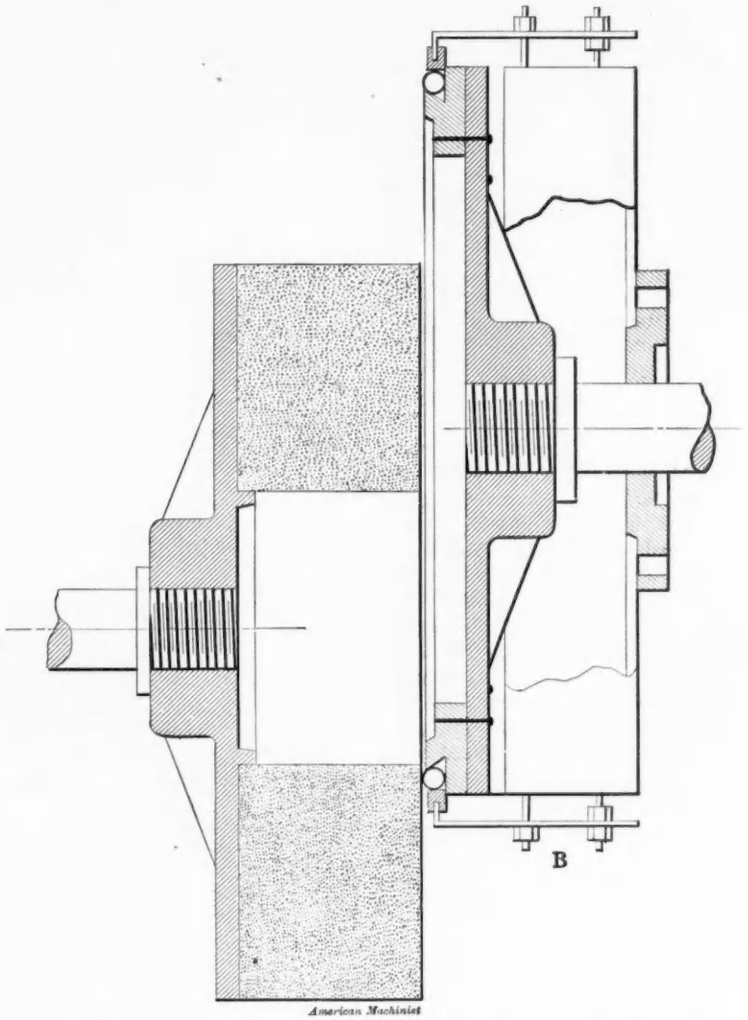


FIG. 4. SECTION SHOWING ACTION OF THE ROUGH GRINDING MACHINE.

The means for producing a gyrating instead of a plain rotating motion of the balls consist in cutting the V groove in the

steel ring with one wall perpendicular to the axis of rotation, and the other wall inclined about 60 degrees from it, and in directing the pressure on the balls in a line parallel with the perpendicular wall, thereby giving unequal resistance between the bearing points of the ball in the groove. To this construction of the ball-carrying devices is due the fact that all the balls come out practically uniform in size and sphericity. No "peg-top" or other abnormal shapes are ever made by these machines. The capacity of these machines is large, since they need not be stopped for either filling or emptying the hoppers, or for examining or gaging the balls. In fact the wheel cuts all the time to its full limit of capacity, removing from 40 to 50 pounds of stock per day from the balls. Water is caused to trickle on the balls to hold the temperature within the proper bounds and thereby prevent the steel from clogging the grinding wheels. Without the water, the balls would become blue and the softened steel would endanger the wheel by "glazing" it, and thereby generate local heat, which might burst it. The water also keeps down the dust which ordinarily accompanies the process of grinding with an emery wheel.

Fig. 6 shows the hardener at work. As previously stated, the hardening is done by automatically passing the balls through a heated muffle, and dropping them into water. The muffle is about 36 inches long and 4½ inches internal diameter. It is made of cast iron, and has a deep internal thread of 2¼ inches pitch. This thread confines the balls and causes them to be carried through the muffle positively, instead of rolling along promiscuously. Means are provided for varying the speed of the muffle, thereby regulating the temperature at which the balls are permitted to fall into the water. It is obvious that by increasing the speed of the muffle the balls are given less time in which to absorb heat, and *vice versa*. When a sufficient quantity of balls has accumulated in the cooling tube, it is pulled out of the cistern, carrying the balls with it. The tube is emptied by opening a trap door at the bottom, and letting the balls fall into a tote box.

The fine grinding, or lapping machine deserves something more than passing notice, as it exhibits the happy combination of the very essence of simplicity in construction with the most satisfying performance. Here is found Laplace's theory of probabilities degraded from its high estate of a pure science, clothed in a garb of plebeian cast iron and made to perform commercial drudgery, a task from which it, happily, does not flinch.

When many millions of balls are to be cheaply ground within a limit of variation from absolute sphericity and fixed size, of less than one ten-thousandth of an inch, it may be readily understood that the machine must be constructed on true principles, else an element of uncertainty would attach to every grinder load and defeat the purposes aimed at.

Fig. 7 shows the fine grinder opened for inspection. As will be seen, it consists of one web gear 30 inches pitch diameter, and two side-plates of about 28 inches diameter. The gear when cast is about 1½ inches thick in the web, and the plates are 1¼ inches thick. Ordinary V grooves of 90 degrees angle are cut in both sides

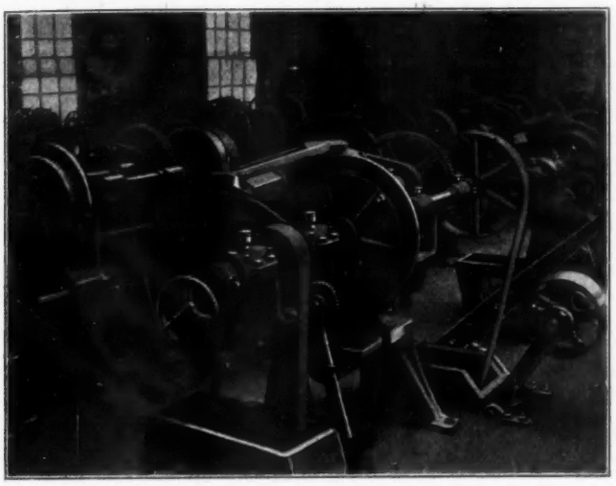


FIG. 5. A SET OF ROUGH GRINDING MACHINES.

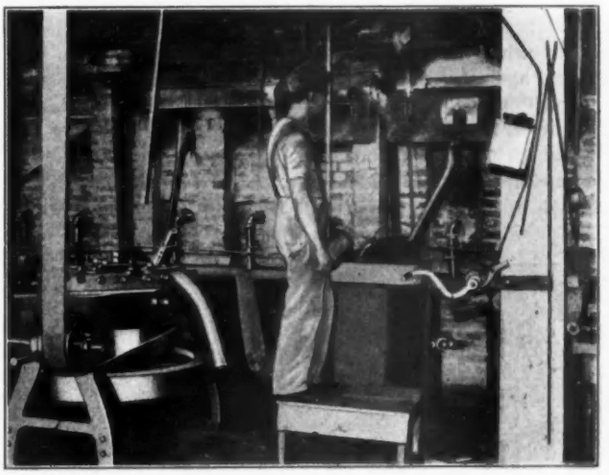


FIG. 6. AUTOMATIC HARDENING FURNACE.

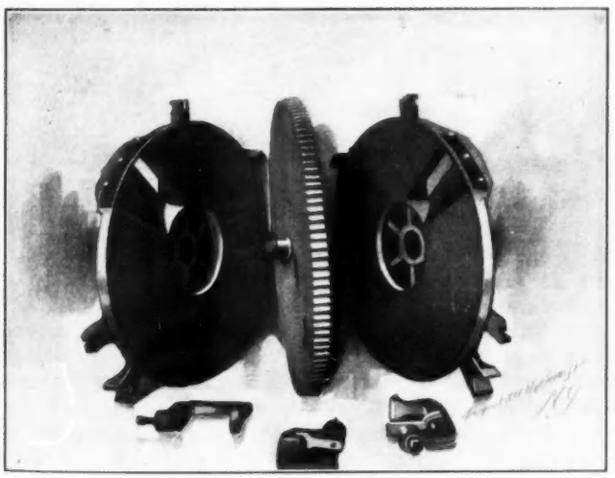


FIG. 7. FINE GRINDER, OPEN FOR INSPECTION.

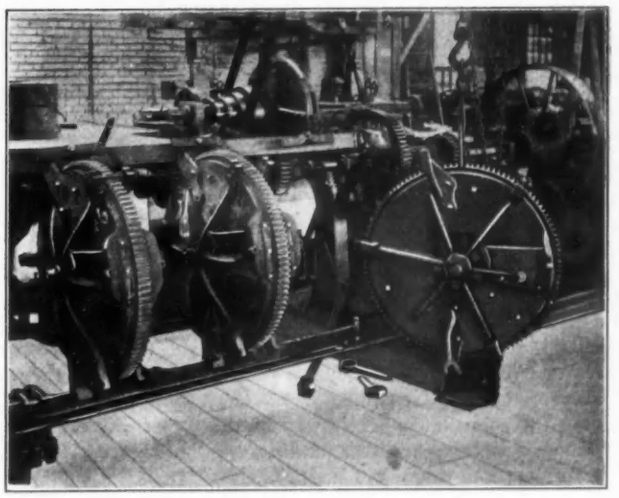


FIG. 8. FINE GRINDING IN LOADING RACK, ONE OUT.

of the gear and in one side of each of the plates. These grooves meet when the machine is put together, and form channels through which the balls pass in grinding. The openings shown in the plates are the hoppers into which the balls are fed in loading the machine, and from which they are from time to time taken for gaging, as the grinding progresses. These hoppers are merely openings through the plates, cored so as to leave a thin wall at the back of the plate, to form a sort of rectangular funnel, termed the hopper. Strips of steel transversely grooved to match the grooves in the plates are placed at the lower edge of the hopper, to lead the balls into the grinding grooves. The plates are held against the sides of the gear by a bolt passing through the central bore of the different parts, and furnished with a nut and spring washer, to produce a yielding pressure. Spring clamps are used in addition to the bolt and spring washer, to distribute the pressure as evenly as practicable over the surface of the plates.

Fig. 8 shows the grinders assembled and put in the loading rack, where they receive their charges of balls and are made ready for the actual grinding jack. One of the three is shown on its way to the grinding jack, being hoisted and sent along on an overhead tramway, and switched into place. In Fig. 9 the grinding jack is shown ready to receive grinders, and filled with them, in Fig. 10. Each jack carries eighteen grinders—nine on each side—and will, with the labor of one attendant, grind 225,000 assorted balls of bicycle sizes in ten hours. The grinders are loosely dropped into the jack, and are held in position throughout the run by merely putting in place a slight confining bar for each, plainly seen in Fig. 9, at the top near the gear teeth. The attendant does not gage the balls; a separate gager is employed, whose duty it is to gage small sample lots from each grinder, at certain intervals, and to note the size of the balls on cards hung over each machine. These cards keep the attendant fully informed of the progress of the work and enable him to stop the machine when the batch is finished.

The *modus operandi* of fine grinding is as follows: A grinder is put in the loading rack and receives a certain weighed quantity of balls (more than the grooves can hold at once) in each side or hopper; it is then slowly run for three or four revolutions, when it is found that the grooves are all filled with balls and a considerable overflow left in the hoppers. The machine is now ready to be switched into any unoccupied space in the grinding jack. When settled in position, the gear meshes with the driving pinion, and the grinder is ready to start on its regular run, which lasts from seven to ten hours. Each driving pinion is furnished with a clutch and lever, so that any individual grinder may be independently started and stopped at will. In grinding or lapping the balls, no oil is used as a vehicle for the emery, and consequently no gasoline or benzine is needed to clean them for gaging or inspection. The grinders are charged by the attendant from time to time with No. 100 emery and with enough water to keep it in a pasty mass, a little soda being added to prevent rust. The attendant's effort is directed toward keeping the mass of emery and water of proper consistency, to maintaining the tension on the plates at the proper point and to watching the gaging cards, so that he may stop the machine at the right time and have it taken away to be emptied.

Now observe wherein the theory of probabilities takes the leading part in dealing with a batch of balls. It is understood that the sides, or plates, are stationary and that the gear revolves between them. Let us trace a single ball through the early stages of fine grinding. For an illustration, we will suppose the ball to be about ten thousandths of an inch out of round, and a like amount larger than its mates. Upon starting the grinder, the ball immediately passes into a groove, makes one circuit, and is then discharged into the hopper, and falls on top of the general lot of balls already there. It is then subjected to the barber's rule of "first come, first served," and cannot make another circuit until approximately all the other balls in the hopper have found passages, when it again makes an excursion or circuit, probably this time in a groove remote from the one it previously passed through. We have supposed that it is at the beginning the largest ball in the batch; this obviously causes it to receive greater pressure at each passage than a smaller ball would get, and consequently it is more actively reduced until it equals in size the balls that were smaller at the start. Now, this large ball not only receives more active treatment, but distributes its destructive action on the grooves over the whole plate, whereas if the grooves were continuous, it would confine its mischief to one groove, and soon unfit that one for making the proper size or shape of ball. Suppose, again, that our ball happened to be of such a form at the beginning that it had a greater tendency to roll in one particular plane than in any other. It would then, if confined to a continuous groove, do what it could to disqualify that groove for grinding to sphericity the other balls contained therein.

In Hill's machine the case is totally different. Here a wheel of 28 inches working diameter contains, say, 42 grooves of successively reduced diameter for ⅛-inch balls. It makes 75 turns per minute, and is loaded with 18,000 balls on each side. Each ball revolves while confined in the outer groove, at the rate of about 30,000 turns per minute, and is compelled to stop and mingle with a mass of balls each time it has made one circuit. Now, the probabilities are that any given ball will be repeatedly acted on by all the grooves, and that any given groove will be similarly acted on by all the balls, thereby mutually

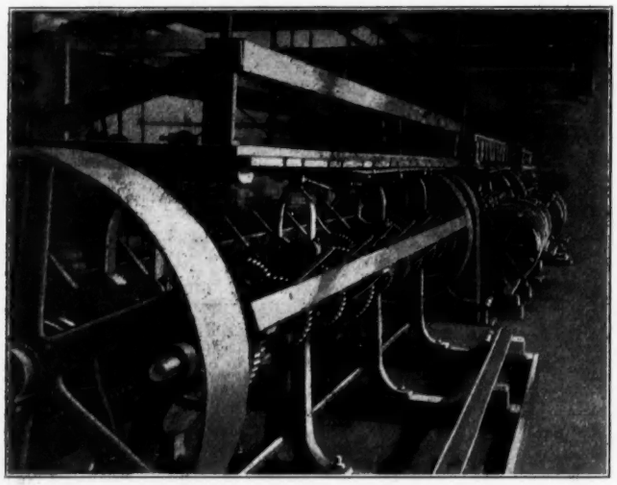


FIG. 9. VIEW OF FINE GRINDING JACK, EMPTY.

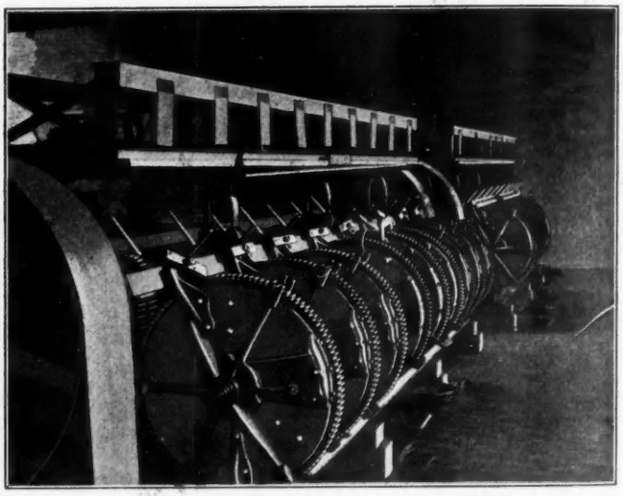


FIG. 10. FINE GRINDING JACK FILLED WITH GRINDERS.

correcting each other, until no further improvement in the figure of the ball can be made. This is found in practice to be true, and is the inherent property of these machines which enables The Steel Ball Company to guarantee that the balls manufactured by it do not vary more than one ten-thousandth of an inch from a fixed standard, either in size or in sphericity. Astonishing as this guarantee may seem to a practical man to be, Mr. Hill declares that he will undertake to grind millions of balls within one fifty-thousandth of an inch, if someone will furnish measuring tools of sufficient delicacy and precision.

After the grinding has been completed, there remain the processes of cleaning, polishing and inspecting the balls. Familiar methods are employed for polishing, the machines used for that purpose having no radical points of difference from those of other ball makers, but combining efficiency with capacity to such an extent that the labor cost is reduced to the minimum.

When the balls have been polished to a high degree of brilliancy, they are most carefully inspected by experts, whose duty it is to detect and throw out all balls that show any defect whatever. The inspection is the final step in the evolution of the steel from the coil or rod to the perfect sphere, and is the only one in which automatic machinery is not employed. It is also the only one where skilled operatives are required, for in this operation science is powerless, and the human eye must pass on the work which the machinery has performed.

Cost Keeping at the Chicago Works of Fraser & Chalmers—I.

BY J. A. THOMAS.

Much has been written and published in the last few years concerning the costs of building machinery and the methods to be employed to secure reliable cost accounts. Most of these articles, and many of them have been extensive, have, however, dealt in generalities only, and have shown little of practical value. They have therefore been of little value to the reader, searching for information that would enable him to put his shops on a better paying basis by reducing the cost of production, helping to make safer and more comprehensive estimates for quoting prices and at the same time securing such information at less cost than is generally incurred in operating the average cost system. At least this has been the experience of the writer.

After searching for information along these lines and reading everything he could find, with the object of perfecting a system of cost-keeping, the system described in this series of articles evolved itself, and has for four years been in practical operation, with the result of a saving of thousands of dollars yearly in the cost of the production of one concern.

While placing this system in operation and during the time that he operated it, the writer had the privilege of visiting many of the best shops and investigating their methods of cost-keeping, and also of talking extensively with other manufacturers on the subject. Many of these parties were using systems in which were incorporated some of the salient features of this one; but, taken as a whole, these systems were quite inferior in the matter of getting at detailed costs, and at the same time did not give such final results as to be satisfactory for estimating purposes.

It may appear from the description given here of this cost system that it is complicated and difficult to install. This is common in descriptions of this kind; but, in point of fact, if an accountant will read this paper carefully so as to understand its details, he will find that it is exceedingly simple, because of each operation depending upon the completion of the one just preceding it. Its particular and special aim is to give ***detailed*** costs, and as it is in successful use in a shop employing nearly 1,500 men, the experience gained in using it may fairly be considered valuable.

To anyone desiring to install this system and thus better his condition, it is the advice of the writer to start the system full-fledged. Get all forms printed as described or with such alterations as will more nearly meet the requirements, and then employ the new system on all jobs of no matter what size that come into the shop subsequent to the time of starting. The books under the old system may be closed up as the old jobs are finished.

It is claimed for this system that because the clerical force is concentrated and the number of clerks in the separate departments of the shops reduced to a minimum, the chief cost accountant has the men directly under his eye, thus permitting him to get out of them the maximum amount of work.

It is generally considered that on account of the constantly varying cost of repairs, supplies and expenses of administration, to say nothing of the variation in the cost of producing duplicate articles at different times, the most accurate account of cost is only an approximation. That is true, the aim being to make this approximation as nearly correct as possible. In many cost systems an arbitrary amount is taken to cover the item of expense. There is a large element of uncertainty about such methods, as while the amount may be known to be safe, the margin of profit cannot be shown on any one job. At the end of a year's business it is known that a profit or loss was sustained on the whole year's business, because the balance sheet shows it, but it is difficult or impossible to tell what jobs this profit or loss came from, or which branch of the business was the most profitable. At times this statement is in error, because some particular job will show an enormous profit or loss, but in general such figures are of little use in estimating and of no use when prices must be made close to actual cost to meet close competition, and at the same time leave the contractor a reasonable assurance that he will not meet with serious loss on the contract.

When a loss is incurred upon a certain job it is important that the builder should know in what department the loss was caused, where the extra time was wasted and the money spent. When he has this information before him he has actual figures to carry to the foreman in whose department the time was wasted or to permit comparisons with the cost of past or future similar jobs. Anyone who has ever been connected with shop management and had to deal with cutting down costs of production will readily see of what inestimable value this feature is.

The fundamental principle of this system is the one that permits us to get an accurate account of all money paid out on a job; *i. e.*, it gives us the cost of each operation on the most minute piece, the cost of the whole piece and the cost of the entire job, in actual money paid out for labor and materials. For each hour of time consumed on the job is added an amount of money to cover expenses which we chose to call "Burden." The actual money paid out in wages, plus the cost of the material, plus the "burden," is the actual cost of the job.

BURDEN.

It is obvious that as one department of the works will use more supplies and incur more dead expense than another, the "burden" of the departments should vary accordingly. There will also be a "burden" due to general expense, such as administration, taxes and insurances on office, etc., that cannot be charged to any one department, but should be borne by all departments *pro rata* with the amount of work done in each department.

We open up a set of "burden books," one for each department and one for the "general account." These books are ruled like an ordinary day book or journal and are in the nature of memorandum books, being additional to the ledger accounts. Their object is the collection of all items of expense in one place, and properly detailed, instead of distributing them among several accounts and summarized only, as in the ledger. They are thus in shape for study by the manager, this study being further facilitated by the fact that, except when being posted at the beginning of each month, the books may be kept on his desk, whereas the ledger must necessarily be at the accountant's desk. Ordinary stock journals kept by any stationary store will answer every purpose. Books having pages 8x12 to 14 inches in size and containing about 200 pages are convenient to handle and will last for a considerable time. In these books we record all dead expense—*i. e.*, expense that cannot be charged directly to orders, such as oil waste and similar supplies, and all coal

for the several departments; or if power is delivered from a central power plant, the power account should be divided among the departments according to the amount each uses, or be placed in the general account when these amounts cannot be determined. All dead or non-productive expense, such as that due to foreman, and labor which cannot be charged to orders and repairs on tools, must be here charged to the department incurring the expense.

In these same books is kept an account of the total number of hours worked in the different departments and the number of hours worked but not charged to orders, these latter being kept in separate items, such as "running crane," "sweeping," etc. These amounts of time recorded and not charged to orders are subtracted from the total number of hours worked, leaving as a remainder the number of hours charged to orders. This method is used simply because it is easier to add up the hours not charged to orders than those charged to orders, as there are fewer of the former. The total number of hours worked in each department is reported by the time clerk daily from his pay roll.

The entire amount of dead expense for the month in each department being determined, it is divided by the number of hours charged to orders during the month, in order to find the amount of money that must be added to the workman's pay for each hour's work that is charged to orders in that department. This amount is called the *department burden.*

The *general burden* is found in the same way. For the expenses in the general account only such items of expense are used as apply to the general business and not to any one department. The total general expense divided by the total number of hours charged to orders from all of the departments gives the general burden, which when added to the proper department burden gives a sum to be added to the wages paid for each hour's work in that department. The two burdens added together constitute the total burden of that department.

It must be borne in mind that pay for all time put in by roust-abouts and others whose time cannot be charged to orders must be put into the expense account of that department.

Note—Some have argued against this method of dividing up the dead expense, saying that the burden added should be a percentage of the wages, instead of a fixed amount per hour. This is incorrect, as the following comparisons will show:

Suppose the cases of a journeyman earning $2 per day, an apprentice earning $1 per day, but, by reason of quick wit and alertness, doing as much work as the journeyman; and a second apprentice, also receiving $1 per day, but doing only one-half as much as the journeyman. Assuming a burden of 100 per cent., the wages of each one must be doubled to obtain the cost of his day's work.

Assume that the journeyman and the first apprentice each occupy a day to do a given piece of work, while the second apprentice requires two days. On this plan, with 100 per cent. burden, the costs of the different men's work are as follows:

	Wages.		Burden.		Total.
Journeyman	$2	+	100 p. c.	=	$4
First apprentice....	1	+	100 p. c.	=	2
Second apprentice..	2	+	100 p. c.	=	4

Comparing the work of the first apprentice with that of the journeyman, there is an apparent saving of $2. This, however, is impossible, since the time of the machine consumed is the same in both cases, and hence the burden must be the same. The only real difference is the difference in wages, which is $1, and not $2 as the figures have it. Comparing next the work of the second apprentice with that of the journeyman, the apparent cost is the same, but the fact is that while the wages were equal, the apprentice used the lathe two days, and the journeyman one, the charge for the use of the tool being $2 for one day in one case and $2 for two days in the other. Clearly this must be wrong.

On the hourly burden plan, with a burden of, say, 30 cents per hour, the figures for costs would be like this:

	Wages.		Burden.		Total.
Journeyman	$2	+	$3	=	$5
First apprentice.....	1	+	3	=	4
Second apprentice...	2	+	6	=	8

This would show the quick apprentice to be a money-maker and the slow one a money-loser, as it should.

EXPENSE ACCOUNT IN BURDEN BOOK.

In entering the items in the expense accounts, it is well to adopt a regular order, in order that they may be more readily found and compared. This comparison should be made every month by someone in authority, to see that the expenses do not creep up or, if they do, why. The accounts are to be made up on the first of each month for the preceding month, and care should be taken to enter expenses incurred during that month only. These amounts are entered from the invoices received and from the time-slips put in against dead expenses, which are kept separated in the drawer properly classified as to class of work and departments. At the end of the month these time-slips are taken out of the drawer, and, after verifying the classification, they are footed up as to number of hours and amount of wages, and properly entered in the burden book for the proper department. After each department burden book is footed up for the month, the total time charged to orders, the total time not charged to orders and the total time worked are entered in the general burden book, for each department separately, and then footed up.

The pages upon which are entered the items of time not charged to orders should be arranged uniformly to expedite future comparisons. These comparisons are valuable to show what reductions can be made in time charged to dead expense, and as a check against promiscuous dead-expense charges.

The burden is figured for all departments in the same manner, including the drafting room.

(*Concluded next week.*)

A Twisting Operation.

BY C. H. ROWE.

The essential features of a recently constructed punch and die for twisting the ends of strips of sheet metal are shown in the sketches. The device uses the movement of helical-grooved plungers to make the quarter turn, as required by the work. The idea was first suggested to me by Mr. George Freeman, an ingenious tool and die maker of Lynn, Mass., and, with the usual care in the making of the dies, it was brought to a very satisfactory working condition, the work being uniform and the production rapid.

The work, Fig. 1, turned out by the tools here described was hard brass, with the ends annealed where the twist was made, 3/8 inch wide, 1-16 inch thick, and of sufficient length to make the pieces according to specifications, which operation consisted in turning up the ends at right angles for 3/4 inch in an ordinary plain-bending die, and then making a quarter twist for 1/2 inch on the ends with the punch and die here described.

The cuts show an axial section of the punch and a plan of the die respectively. Upon reference to Fig. 2, which shows simply a cast-iron piece 3x7 inches, and 1 inch thick, the sides were beveled 5 degrees for keying it into the holder. *A A* are pieces of tool steel 1/4 inch thick, hardened and fastened to the die by two screws *B* in each and dowel pins *C* to secure their alinement with the base; at *D* the corners are filed away to permit the work to extend out over the gages at this point when the twist is being made. These gages are for locating the work in the die, and for the ends of the helical plungers *C*, Fig. 3, to rest on when the operation of twisting is performed.

A, Fig. 3, is a cast-iron block with the various holes machined in it to receive the operating parts of the punch. *B B* are bushings with a one-inch hole bored through them and turned and finished on the outside to fit the piece *A* closely. After these pieces were ready, the next step was to make helical plugs *C C*. We first centered and turned them to an easy running fit in the bushings *B B*, then took them to the milling machine and cut the helical grooves 5-16 inch deep 1/4 inch wide with a pitch of 3.24 inches, down from the top about 2 inches. They were of course cut right and left. Holes *D D* were next drilled through and *E E* up from its lower ends to meet them. The shaper was used to

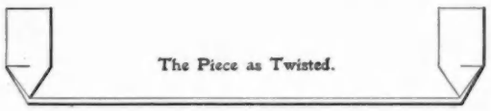


Fig. 1

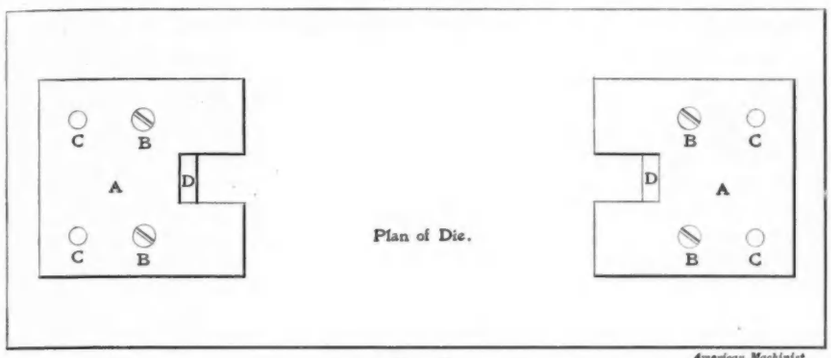


Fig. 2

THE PIECE AFTER TWISTING AND THE TOP OF THE DIE.

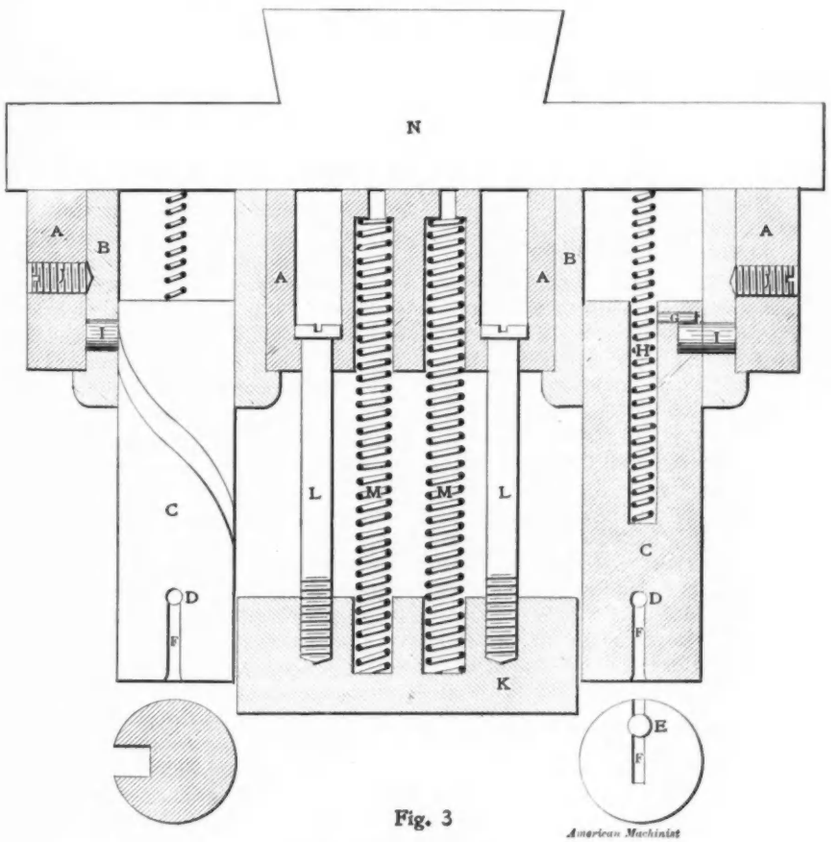


Fig. 3

THE TWISTING PUNCH.

plane the openings *F F* 3-32 wide and of the necessary depth to allow the work to be central with the axis of the vertical spirals, the holes *D D* serving for clearance for the shaper tool. The openings *F F* are flared to receive the ends of the work on the descent of the punch, and to obviate the possibility of an accident in case there should be a variation in the quality of the metal, or if the distances between the ends of the strip when bent perpendicular were not quite uniform. The holes for pins *G* and springs *H* having been entered, the plungers were hardened and drawn to a light straw color. Steel pins are driven into holes *E* to effectually close up the openings *F F* on the sides. The pins *G G* on the extreme upper ends of the pieces *C C* are to limit their downward movement and prevent them being forced out of the bushings *B B* by the springs *H H*. *I I* are ¼-inch studs made very hard and fitted tightly into the walls of the bushings and entering the helical grooves of the plungers very nearly their full depth. These studs cause the pieces *C C* to make the quarter turn that is required to twist the work, after their ends come in contact with the faces of the gages *A*, Fig. 2, and while the ram of the press continues on the downward stroke.

The bushings *B B*, having been entered in the casting *A* and turned round to bring the spirals, when extended to their full limit, in line to receive the work, are spotted and drilled for the pointed screws *J J* that hold them permanently in place. The tension of the springs *H* is just sufficient to keep the spirals extended when free from the work.

The spring pad *K* is retained by the screws *L L* and pressed down by the two stiff springs *M M* that act to keep the work flat on the face of the die during the action of twisting, and to strip it from the spirals on the upward movement of the punch. After assembling, the punch was screwed and doweled to the plate *N*, the upper ends of the coil springs *H H* backing up against the under side.

A Handy Tool Sharpener.

The word "Sharpener," by which the emery grinder shown in the half-tone, Fig. 1, is designated, is used advisedly. The machine is not intended for the heavy grinding or shaping of tools, but simply for retouching to keep them sharp, and it is to be placed around the shop wherever most convenient for the workmen. It may be placed on a bench when desired or on a column, as here shown, this latter arrangement being preferable.

Referring to Fig. 2, it will be seen that the wheels do not run in water, but are suspended directly over the water, the

FIG. 1. AN IMPROVED TOOL SHARPENER.

grinder head being supported by the hood, and swiveled so that it can be turned horizontally to a consiberable angle from its normal position and clamped there by a set screw. The head itself also may be turned to bring the opening in the most favorable position. As the belt is vertical, these changes of angle do not interfere with its proper driving up to nearly 180 degrees in either direction. The bowl of water not

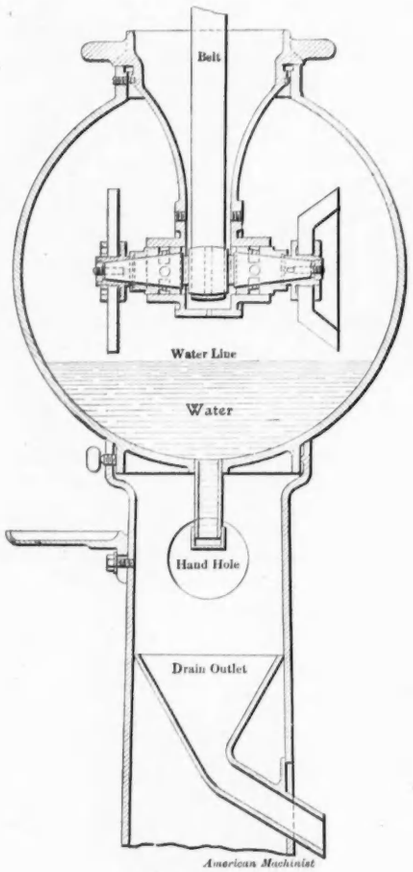


Fig. 2

VERTICAL SECTION OF TOOL SHARPENER.

only is useful for cooling the tools, but also for receiving and retaining the dust. It is drawn off by holding a bucket under the spout and removing the cap at the bottom of the vertical pipe, for which purpose a hand hole is provided. Three set screws bind the top swivel, the points of the screws fitting in countersinks in segments of a ring which fits in a groove in the revolving part. The screws thus do not cause wear by frequent adjustment, and being so placed as to exert a downward or binding pressure, there is no possibility of vibration. The spindle is taper at each end and the gun-metal boxes have longitudinal movement for adjustment. The taper of the spindle is continued out beyond the boxes, and on these taper ends the centers of the wheels are fitted, and are interchangeable. The ends of the spindle are threaded right and left with annular nuts which fit into cavities in the wheel centers, the nuts being doweled at their peripheries to the centers, so that the wheels may be taken off or exchanged without the use of a wrench, the nut turning with the wheel center. The spindle is oiled through capped tubes not shown, which communicate with annular chambers in the boxes.

The grinder rest supports swivel about the large hubs in which the taper boxes are secured. They thus have vertical adjustment. The rests proper have horizontal cylindrical portions which may be slid in or out and turned backward or forward and clamped by a thumb screw, as required.

While a sharp corner on a tool-grinding wheel is a very desirable thing, it is a most difficult thing to maintain. With this sharpener is furnished a beveled cup or conical-shaped wheel as most nearly fulfilling the requirements, the acute angle and the end wear together tending to maintain the sharp corner. An ordinary disk wheel also is furnished. Other shapes may of course be used if preferred. An electric-light holder can be supplied also and a motor driver for the machine will soon be ready. A countershaft is furnished with the machine. It is built by O. S. Walker & Co., Worcester, Mass.

Interchangeability.

The "Mechanical Engineer," of Manchester, England, in a recent editorial undertakes to settle the question as to who invented or originated the modern interchangeable system of manufacture, and assigns all the honor which may attach to it to Eli Whitney, who in 1798 took a contract from the United States Government to supply 10,000 muskets. He was driven to employ the system, as alleged, curiously enough, by the scarcity of skilled labor, which latter complaint, it would seem, is not the novelty that some to-day would have us believe.

As to interchangeability, or the abilty of each similar piece produced to fit where every other similar piece will fit, it may almost be said that there never was any beginning, and it is only an incident instead of the essential feature of modern manufacture. In laying up a wall the bricklayer takes up any brick nearest to his hand, well knowing that it will lap over his two bricks already laid, as well as any other. That is perhaps the roughest sample of interchangeability. When a line of water pipe is to be laid, the castings are dropped indiscriminately along the road, with full assurance that one end of each will fit into the end of the preceding one. This is interchangeability more restricted but just as certain. In these days, in a watch factory, all the screws of the same style and the same nominal size will fit into the same place in the watch, which is interchangeability on a different scale. Interchangeability is as easy of accomplishmeut and of as frequent occurrence with rough work as with fine work. With the finest work produced by man it still never means absolute precision and identity, and none know it so well as those who measure most minutely and work most precisely. Interchangeability is merely a measure of the limit of accuracy in the parts which are to interchange. Make the limit wide enough and everything will interchange. The only thing, and it is not a little thing, which the modern manufacturer may boast of in connection with the interchangeability of parts is in the fixing of the limits and in the minuteness of their range.

The first aim of the modern methods is to produce cheaply and therefore rapidly. These methods have not been adopted, as is so frequently charged, on account of the scarcity of skilled labor, but because the highest skill, however plenty, has been proved to be inadequate. The highest and most prolific development of human skill would not in the least promote a return to the old methods of individual production.

The twist drill is not used in preference to the old flat drill on account of the scarcity of skilled labor, although it very distinctly dispenses with much of the skill and care (which, indeed, is a chief element of skill) once required for continued accurate drilling. It should be a simple thing to drill a lot of holes precisely alike—until one tries to do it—and then for the interchangeability of a lot of pins to fit them one-half is at once accomplished. All that is required for the accurate repetition of a drilling operation is a perfectly homogeneous material of uniform hardness, constant feed and speed and lubrication, and then cutting edges that will not wear. The latter particular is of course, most impossible of all, and with the flat drill only a frequent renewal of it, with the skill required for shaping and sizing it at each renewal, could maintain an approximation of the desired result. With the twist drill there is required only an occasional sharpening and the size is marvelously maintained. So in all the operations pertaining to the production of interchangeable parts, the skill formerly employed in directing or adjusting the cutting or abrading agent for each individual piece produced is now done away with, and improved facilities enable us to adjust cutting tools that will each do its part on many pieces, and the most responsible work is now the occasional readjustment of the cutters, for which the means are provided, and a constant alertness with gages and test pieces and samples to keep the results within the assigned limits. Rapid and profitable manufacture consists in producing articles very nearly alike, and then very narrow limits of variation guarantee complete interchangeability. Skill still dominates the work, and skill of a higher type than ever, but the skill is concentrated upon the responsible operations and in the situations where it was made so essential as now.

Steam Ports—Port Opening—Lead—Slide Valve Dimensions—Compression—The Sweet Valve Diagram.

BY J. BEGTRUP.

A diagram from which all the functions of a plain slide valve may be obtained is shown in Fig. 1, which is self-explanatory. Note that valve measurements and port openings are taken at right angles to the oblique lines, and that *these lines must be parallel.* For convenience, the eccentric-circle is drawn full size and the crank-circle is reduced, so as to make both circles appear of same size.

From this circular diagram a theoretical indicator diagram can readily be constructed, as shown, which adds greatly to its usefulness; for to many engineers the indicator diagram exhibits and explains, at a single glance, all the peculiarities of the steam distribution in the cylinder, and it sometimes contains a whole story in graphic language.

This valve diagram, slightly modified, was first published by Professor John E. Sweet, in the "American Machinist" of August 30, 1884, * and I know no reason why it should not be named the "Sweet valve diagram." No attempt should be made to use the same diagram to indicate different valve proportions or settings, for it makes it confusing to the eye, and it is entirely unnecessary, as half a dozen such diagrams can be drawn "in less than no time."

In order that the opening and closing of the ports may take place at the proper moments during the forward stroke and return stroke respectively, the eccentric must be set at a certain angle in advance of the crank, and its location depends, therefore, on the *direction* in which the crank turns, though the angle of advance is the same in either case. A reversal of the crank motion would change the valve diagram, only so far as all points above the center line would occupy corresponding positions below it, and vice versa—as if the diagram were turned around its horizontal diameter.

VARIABLE VALVE TRAVEL.

A glance at the diagram shows that *the longer the lap the shorter the period of admission, and the smaller the port opening;* but it should also be noted that the length of periods of admission and exhaust depends absolutely on the *relation between lap and travel of valve,* and that, therefore, shortening the travel has the same effect as increasing the lap, so far as these periods are concerned; but shorter travel yields smaller openings for admission and release.

The location of the point of cut-off can be changed by changing the lap of the valve and the angular advance * of the eccentric, and it is evident that this can also be done by changing the throw of the eccentric and its angular advance, without changing the valve. For instance, by diminishing the throw the period of admission becomes less, and by advancing the eccentric the proper lead is obtained, which will become clear by an inspection of diagram Fig. 1. Improved slide valves are often driven by shiftable eccentrics whose throw and angular advance are automatically changed so as to vary the point in the stroke where steam is cut off, as for instance, on many high speed engines; or the same result is obtained by hand adjustment, as on the locomotive.

LIMITATIONS OF THE COMBINATION VALVE.

The main limitation of the D-valve, or combined steam and exhaust valve, as a steam distributor, is due to the fixed union of its steam and exhaust edges, as when separate steam and exhaust valves are driven by means of one rod. Maximum steam and exhaust opening must occur when the eccentric is at either end of its stroke, just in the middle of periods of admission and exhaust respectively, and there being only one eccentric, this must occur at diametrically opposite points in the period of revolution. If, for instance, the admission period is fixed, the exhaust period can not be arbitrarily changed; for, the eccentric being fixed on the shaft to suit the admission period, we can only vary the exhaust period by varying the exhaust lap, but this will give a variation in both directions, that is, if the exhaust opens earlier it will close later, and if it opens later it will close earlier. The cycle of contiguous events, as marked on the eccentric circles, shows this clearly, also that an early cut off of the steam in the cylinder is followed by early release and an early exhaust closure, and consequently by much compression of the exhaust. It is, therefore, quite common practice, when not exhausting into a condenser, to omit the exhaust lap. Moving the exhaust edge back still further would probably give too early release.

It should be noted that the functional restrictions here mentioned are inherent in any combination of a steam and exhaust valve *conjunctively driven by a connected valve gear of any description,* because such valve gear must derive all its motions from the engine, and its alternations must follow closely those of the engine; and that, therefore, the argument in support of the above maxim holds generally without reference to the eccentric or to the nature of the valve gear—the only restrictive condition being that there be at least *one common rod-connection* in the valve gear.

The increased compression which follows an early cut-off is sometimes considered an unavoidable evil or inherent defect, and sometimes a desirable feature or incidental advantage of the combination slide valve, according to existing conditions or various theories.

It should be noted that by an early cut-off the steam opening is much restricted, and particularly so near the point of cut-off, where the steam flow is comparatively rapid. The most natural remedy would be an increase of the valve travel, but in case of an unbalanced valve, this would increase the unbalanced area and the friction proportionally. When it is desired to limit the valve travel, duplicate or supplementary steam ports are sometimes resorted to. The restriction of the port opening, however, is of little consequence, unless the steam is cut off very early in the stroke; and the attendant early release is probably the most objectionable feature. Very early cut-off is only used in connection with a shiftable eccentric or with a link-gear. Great adaptability, simplicity, and compactness are characteristics of the common D-valve, and for engines using steam at low or medium pressure governed by throttling, it will hardly be superseded.

STEAM PORTS.

When designing slide valves, one of the first data required is the size of steam ports. No general rule can be given for this—in fact, progressive engineers consider it an unsettled matter. Much depends on the piston speed, but there are other influential conditions. If it is desired to admit steam to the cylinder under full pressure, larger ports are required than if the pressure is to be throttled down; and if a considerable decrease of speed is permissible under an occasional extra heavy load—as, for instance, by hoisting engines—comparatively small ports give entire satisfaction and are preferable to larger ones. The length and shape of steam passage and port may have an important bearing on their sectional area, but narrow ports are requisite in order to keep the valve motion within practical limits. The discovery may still be made that the passage, and not the port, is the governing element. The "mechanical instinct" of the engine builder will make the port conform to the passage, but this instinct is not reliable when the molecular action of steam is involved. In the writer's personal experience, for instance, an abrupt contraction of the port to l ss than half its original size, as shown in Fig. 2, did not lower the admission line or raise the exhaust line on the indicator card. This phenomenon is susceptible of a rational explanation, but mere speculation is not in place here.

Incidental experiences seem to prove that the condition of the steam, whether wet, dry or superheated, is of no little consequence. Dry steam, being more subtile than wet steam, moves easier or does not adhere to the sides, and therefore does not require so large ports or passages.

* It is sixteen years since this diagram was first published in our columns. It is to be found in no text book on valve gears, and the numbers containing it are now out of print. Its great simplicity and unique character seem to justify its publication again in connection with Mr. Begtrup's observations regarding valve dimensions and proportions.—ED.

* It will be observed that Mr. Begtrup measures the angular advance from the center line of the engine. The more usual measurement is from the vertical to this line at the center of the shaft.—ED.

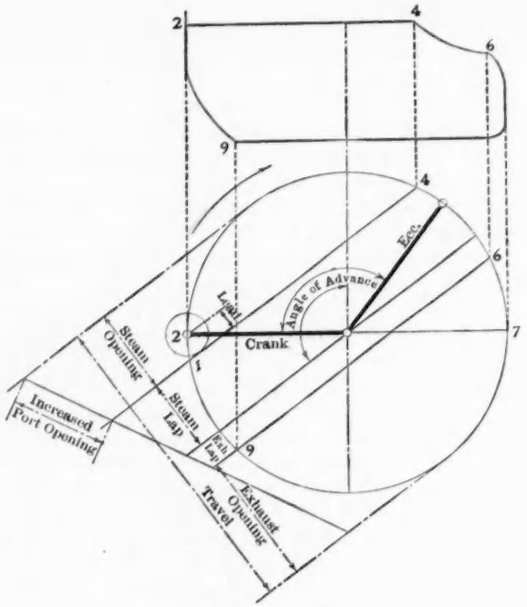


Fig. 1 Sweet's Valve Diagram

Fig. 2 Contracted Steam Port

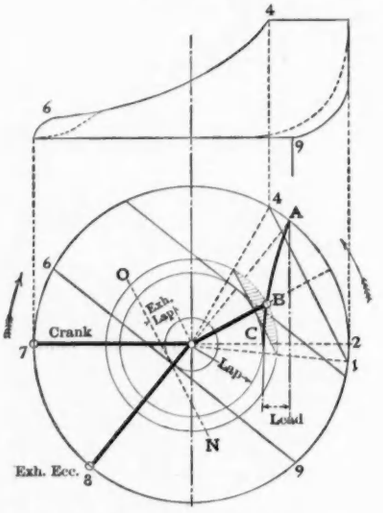


Fig. 3 Sweet's Diagram for Shifting Eccentric Engines

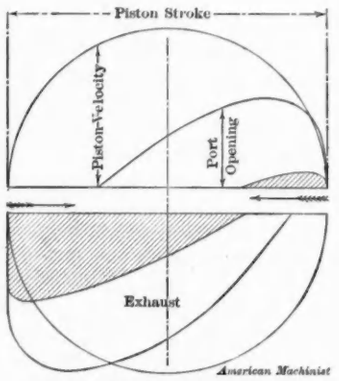


Fig. 4 Port Opening for Different Points of Cut-off

It may safely be assumed that if the ports and passages are large enough to allow the exhaust to pass through without appreciable back pressure, they are amply large for the entering steam, and if the indicator card shows a "good" exhaust-line, the ports are large enough, no matter how bad the "steam-line" appears.

For some years past it has been a rule to make the ports of high-speed engines large enough to make the mean velocity of the steam current 6,000 feet per minute, which for 600 feet piston speed makes the port area equal to one-tenth of the piston area; but occasional experiences indicate that, if the passages are short, a much smaller area may give perfect satisfaction, and the above rule is probably now becoming obsolete.

The rule here mentioned entirely ignores friction against the walls of the passage; this could be remedied by introducing some power of the diameter of the cylinder as a separate factor in the formula. The general formula might, for instance, be: Velocity of steam, in feet per minute, equals 3,000 times the cube root of the diameter in inches. For an 8-inch cylinder this would make the mean velocity 6,000 feet per minute, and for a 27-inch cylinder it would make it 9,000 feet.

PORT-OPENING.

"Port-opening" means the uncovered part of the port, and it should not be confounded with the "port," which is the orifice of the steam passage. The valve may not open for steam as much as the width of the port, for experience has taught that restriction of a steam passage by two sharp edges, within a certain limit, has very little, if any, effect on the steam current. It is known, for instance, that a throttling valve of the piston type does not have to open but very little to allow full-pressure steam to pass through, and on many automatic cut-off engines, the port-opening is much restricted without appreciable loss of pressure.

VALVE DIMENSIONS.

After the travel, point of cut-off and lead have been determined upon, a circular diagram like Fig. 1 may be drawn, and this will give the lap and port opening. If a larger port-opening is desired, the lap and travel must be increased proportionally, or a line may be drawn obliquely across the parallel lines, as shown, so as to give the desired port-opening, and the other dimensions will appear at once, correctly proportioned, on the same line. By this method the lead will be increased with the port-opening, but the *period* of preadmission remains unaltered. In any case, it is advisable to draw a fresh diagram for any contemplated alteration, for the labor it involves is very insignificant compared with resulting clearness and simplicity; and the final diagram should be duly labeled and kept as a record for future reference.

After port, travel, steam and exhaust lap have been obtained, a section of valve and valve seat may be drawn, and it should be observed that the exhaust after leaving the port is not interfered with too much by the opposite exhaust edges. On unbalanced valves it is advisable to reduce the exhaust cavity as much as possible, and in that case the central exhaust opening at the extreme of the travel may be reduced to five-eighths of the area of the steam port by overlapping of the valve.

VALVE DIAGRAM FOR SHIFTING-ECCENTRIC ENGINES.

By making the parallel lines in Fig. 1 slant the other way, as if the figure were turned end for end, we get a diagram which has a certain constructive advantage and also a less desirable feature. It becomes a left-hand diagram for a right-hand crank motion, as it were, and the various valve movements, incidental to the turning of the crank, must be traced out from right to left, while the crank actually turns from left to right. But such diagram will present the slanting lines at right angles to the eccentric arm, which facilitates its construction for valves with variable travel, as used on certain automatic cut-off engines and on locomotives and marine engines.

Fig. 3 shows how to lay out a valve diagram in this manner for an engine having two valves driven by separate eccentrics, one of which controls the steam admission and the other controls the exhaust. The induction valve is driven by an eccentric of variable throw, the center of which is supposed movable, relative to the crank, on the curved path *A B C*, whereby its *throw and angular advance are simultaneously changed.* Thus, when the period of admission is shortened by reducing the throw, *the proper lead is maintained by a corresponding angular advance.* To find the lead in Fig. 3, proceed as follows: With a radius equal to

the lap draw a circle, as shown, and drop a vertical from center of eccentric; the distance from this to the lap circle is lead. In the present case, the lead becomes less as the eccentric advances, and is *nil* at *C*, opposite the crank. When the eccentric is at full throw, the diagram becomes an exact counterpart of Fig. 1 in a reversed position; but suppose the valve were to cut off steam at one-quarter of the piston stroke, *without changing its travel,* then the chord 1-4 would become short and steep, as shown, and the eccentric would be advanced to a position at right angles to this chord, and the lap would have to be increased, as represented by the increased distance of the chord from the center. But as the lap of the valve cannot vary, its travel must be reduced in order to obtain the requisite proportion between lap and travel; and this is effected by moving the eccentric from *A* to point *B*, where a tangent to the lap circle, at right angles to the eccentric arm, will cut off an arc of the reduced circle of rotation through *B*, which arc, or its intercepting angle, represents period of admission within the prescribed limits for one-quarter of the piston stroke. The small shaded segment shows the port-opening, which is remarkably small, considering that such engines often carry full load when the valve is cutting off at that point in the stroke.

It should be noted that the velocity of the piston varies—it is greatest at mid stroke and becomes *nil* at the ends—and that the efficiency of the port opening depends on the local speed of the piston. For this reason only a very small opening is required for admission of steam at the beginning of the stroke; but at one quarter of the stroke the piston speed has greatly increased and in order to get a good "steam line" and a "square cut-off" there should be ample steam opening near the point of cut-off. Fig. 3 shows clearly how unfavorable the conditions are for a square cut-off early in the stroke of single-valve "automatic engines" and locomotives and how incomparably better the conditions become by later cut-off. An early cut-off by a single valve must, in any event, reduce the port opening considerably on account of the long lap required; but by automatic or adjustable cut-off it becomes still smaller on account of the reduced valve travel. It is also worthy of notice that the rapidity of the valve action is less by early cut-off, because this occurs when the eccentric is near the extreme of its travel, where its lateral motion is comparatively slow. The port opening when steam follows one-quarter of the stroke is, in the case here considered, about one-sixth of the maximum opening, or about three-sixteenths of an inch for a 12-inch cylinder.

The exhaust eccentric is supposed to be fixed on the shaft, giving a constant valve travel and fixed points of release and exhaust closure, as in Fig. 1. With direct valve connection and exhaust escaping over the inside port edges, the exhaust eccentric would be in position *A;* but in the case under consideration the exhaust is supposed to take place over the outside edges of the ports, and the eccentric will, therefore, be at point 8, diametrically opposite point *A*.

If steam and exhaust valves were driven by one eccentric, the slanting lines in the diagram would be parallel, and when steam is cut off at one-quarter stroke the exhaust opening and closure would be at *O* and *N* respectively; which means premature release and much compression. By using two eccentrics the early release is avoided, and the compression, being constant, is better adapted to promote smooth running under all conditions. Lap may be used to advantage on a separate exhaust valve.

Note that in this diagram the slanting lines are, as a rule, *not parallel.*

It should also be noted that the opening for exhaust is always ample, and takes place when the eccentric is at or near its half throw, and that, therefore, an early release is not required.

As here represented, the fixed travel of the exhaust valve is equal to the maximum travel of the steam valve; but this is evidently not necessary, as a much shorter travel of the exhaust valve would give ample opening for release. When a single valve controls both steam and exhaust, the exhaust lap is usually omitted; and though the exhaust opening is much reduced by the reduced throw, it is still ample when steam is cut off at one-quarter of the stroke; and as the exhaust lead is nearly constant, the very early release must be detrimental to steam economy.

The ideal indicator diagram annexed to Fig. 2 illustrates the action of an automatic admission and cut-off valve in combination with a separate exhaust valve, and dotted lines show the corresponding action of a single combination valve, the point of cut-off in both cases being at one-quarter of the piston stroke.

If preferred, the diagram Fig. 1 may be used for shiftable eccentrics. It will only be necessary to draw the shifting-path of the eccentric on the other side of the center, where it is to be considered as a construction line only.

VARIATION IN PORT-OPENING.

Fig. 4 represents variation in port-opening. When steam is cut off at one-quarter of the piston stroke, the variation is represented by consecutive ordinates in the shaded areas, and the light areas show the variation when steam is cut off a little before three-quarters of the stroke. Admission and exhaust are here supposed to be controlled by a single valve, and the exhaust opening is represented by ordinates to the lower curve. Ordinates to the crank circle represent—on the proper scale—velocity of the piston, and it will be noticed that at one-quarter stroke it has nearly attained its maximum velocity.

NOTES ABOUT LEAD.

It used to be general practice to give the valve a constant lead, irrespective of the point of cut-off, but the theory in support of this practice is now fast becoming obsolete, and later experience has established the fact that the lead may vary considerably without detriment to smooth running.

Lead means width of port-opening at commencement of the stroke, and no reference is made to the *period of lead* or *lead angle,* as represented by arc 1—2, Figs. 1 and 3, or by its intercepting angle, though it seems quite proper to take this —the time element—in account. Assuming a constant lead, the lead period will vary according to the location of the point of cut-off. By earlier cut-off the steam is admitted earlier to the cylinder, and it has consequently more *time* to fill the clearance spaces; it will be more effective on that account, and it can hardly be disputed that this is of as much consequence as the extent of port-opening at the end of the return stroke—or perhaps more so.

If in Fig. 3 the path *A B C* is made straight and perpendicular, the lead will be constant; and any desired variation in lead may evidently be obtained by making the eccentric shiftable in other directions, more or less deviating from the perpendicular. In the particular case represented in Fig. 3, the lead decreases to nothing at the point of minimum throw, and when the eccentric is near this point, the port-opening becomes exceedingly small; but if the valve has some lead at this point, it will become the minimum port-opening, and it would make a *comparatively* large addition to the port-opening by very early cut-off, and less "wire drawing" of the steam would probably be the result; but according to later theories, wire drawing under these conditions is beneficial, for, by lowering the initial steam pressure, and by rendering somewhat drier steam, it reduces the initial condensation in the cylinder; and it is claimed that in case of a single valve engine, early admission is unnecessary in any event, because an early exhaust closure, incidental to early cut-off, fills the clearance space with compressed exhaust steam.

It is also easily proven that by curtailing the lead, the angular advance is diminished, and release and exhaust closure occur correspondingly later in the stroke.

Negative lead in conjunction with short cut-off has the undoubted practical advantage that it will always insure perfect control of the speed of the engine when running light, whether the valve is set exactly central or not; and it becomes a particularly useful expedient when the engine is connected with a condenser.

If there be any positive lead, the clearance space will fill with full-pressure steam before the commencement of the stroke, and the expansion of this steam may run the engine if the back pressure is light.

Much depends on the clearance space. Let it be 8 per cent. of the piston displacement, and let the initial absolute pressure be 115 pounds per square inch; then the *absolute* mean pressure during expansion of the clearance steam will be 23 pounds; but if the clearance were 4 per cent. of the displacement, the absolute mean pressure would be 15 pounds only. The frictional load is a variable or unknown quantity, and it may be very small when the engine is directly connected with a dynamo. With atmospheric back pressure and heavy compression there is little danger of the engine "running away," but when condensing, the conditions are quite different.

COMPRESSION.

It should be noted that the hight of the compression curve varies inversely as the clearance, and that therefore early exhaust closure is compatible with a large clearance space, while it may be objectionable in connection with small clearance.

In single valve engines and locomotives the work done in the cylinder is partly regulated by the variable compression, and the variation of the point of cut-off is therefore less than where a fixed eccentric governs the exhaust; and the excessive wire-drawing of steam incidental to very early cut-off is thereby partly avoided. Otherwise there is nothing gained by variable compression, for according to D. K. Clark, the absolute loss by initial condensation is nearly constant for all points of cut-off up to 35 per cent. of the stroke; and the ratio of useful work to waste, or the cylinder efficiency at early cut-off depends, therefore, entirely on the work done per stroke of engine, irrespective of the point of cut-off.

The hight of the compression curve in the indicator diagram depends on the point where compression commences, on the clearance space, and on the absolute back pressure or density of the exhaust—the greater the back pressure the higher the curve. And as it may reasonably be assumed that the most economical compression is that which fills the clearance space with steam of nearly same density as the entering steam, the pressure of this should also be taken into account.

From this point of view it appears that under certain conditions the single combination valve may become the ideal valve and that such conditions may exist in the high pressure cylinder of certain compound engines, where the receiver or back pressure varies according to the point of cut-off, being greatest with late cut-off and late exhaust closure and diminishing as the point of cut-off and exhaust closure advances; for this may, under the conditions imposed by a single combination valve, lead to a nearly fixed condition of density of the compressed steam.

Judging from the above remarks it will readily be agreed that a fixed rule for the determination of travel, lap, lead and port-opening may become worse than useless on account of our deficient knowledge of what is required for best economy; and that a wide scope may be given to practical considerations.

Brass Founding—The Use of Scrap Metals in Alloying.

BY C. VICKERS.

Old brass is generally separated by the dealers into two kinds, viz.: red brass scrap and yellow brass scrap, and these are again sorted into heavy red and light red, heavy yellow and light yellow brass. The heavy scrap commands a better price than the light, as it takes up less room, and is easier to handle when melting. A load of heavy red brass scrap will consist of old bearing brasses, valves, oil cups, car brasses, pieces of bells and a miscellaneous assortment of old machinery scrap that it would be useless to attempt to describe. Light red will be composed largely of material that has been rolled. As yellow brass is not so extensively used for machinery as bronze, heavy yellow scrap will be more in the line of old faucets, pieces of tubing, old gas fixtures and trimmings and any yellow brass work that was originally cast. Rolled material, sheet brass, such as clippings and stampings, etc., are classified as light yellow. The above mentioned old metals are not the only ones used in the foundry. In addition we have scrap copper, in the shape of old commutator bars, wire, clippings and copper bottoms; yellow and red brass borings and turnings and white metal scrap, which comes as old cruet-stands, syphon tops, teapots, urns, mugs and silver-plated Britannia ware of all descriptions. This material is known as pewter, and is used largely in place of tin. There are foundries that never use any other materials than scrap in their castings; others use part scrap and part new metal; and a few, new metal wholly.

For the purposes of this article we will imagine we have just received a load of heavy red brass scrap, and that, while we have to use it in order to cheapen our product, our castings have to be turned out of uniform color and hardness. Now, if we use our scrap promiscuously, even if we do put the same quantity in each pot, we cannot be certain that any two heats will be alike, because our scrap may differ widely in composition. In such a case, therefore, it is necessary to first sort the scrap. The large pieces will at once catch our eye, and of these such things as driving brasses, rod brasses, bushings, all bearing brasses except car brasses, we put in a bin by themselves, as they are of hard metal. Car brasses are excepted from this list, because their composition is so uncertain, and so often dishonest. They are liable to contain large quantities of iron, and in any case are justly regarded with suspicion. If the load of brass is composed largely of this material return it, as it is not what you want for general jobbing; let the car-brass man use up his own scrap. Then we may find numbers of valves, oil cups and clean pieces of machinery scrap; these we pick out and put in their bin. This is generally soft brass or steam metal. With regard to the machinery scrap, that we cannot classify; the mere fact of its being clean or otherwise is of course no index to the quality of the metal. It is obviously impossible to give instructions on paper that will enable anyone to sort out and classify this material, as well as one who has had practical experience. In general, all brass that is used on the moving parts of machines will be hard, and that used to resist the pressure of water or steam will be soft and tough. The sorter will probably have seen lots of castings made, and will have an idea of the kind of metal used in them; so when he comes across anything which he recognizes, he will be able to classify it, according to the kind of metal he knows was used in the ones he saw, whether it was hard or soft. When all castings whose quality we can judge of have been picked out, we will have left a mass of small material that, as before remarked, it is impossible to classify. This we can shovel into a bin by itself.

Now that we have got our scrap sorted, we will have some idea of what we are doing when using it in making alloys. According to the character of the work, and our knowledge of the quality of metal required, we can proportion the scrap to the new metal, using one-third, one-half, two-thirds, or all scrap, as the case may call for. A No. 40 crucible will hold 120 pounds of metal; we want to take out a heat of good, ordinary soft bronze, using about two-thirds scrap. As each ingot of casting copper will average 18 pounds in weight, we take two of them, or 36 pounds of copper. The mixture for this may be 2¼ pounds each of tin, zinc and lead, equal to 42¾ pounds of new metal, and added to this 75 pounds of scrap, will make 117¾ pounds, about as much as it is desirable to put in the crucible. When weighing the scrap, we take 50 pounds of soft metal (the valves, etc.) and 25 pounds of the miscellaneous scrap; or, if we have to use some of those car brasses, we can make our mixture 50 pounds valves, 15 pounds small scrap, 10 pounds c r brasses, added to the new metal, and by keeping these proportions constant, the color and quality of the alloy will not materially vary in different heats. We can also use yellow brass in place of the zinc, if thought advisable. The average yellow brass is composed of 2 parts of copper to 1 of zinc. Instead of the 2¼ pounds of zinc, therefore, we may use 6¾ pounds of yellow brass In using this brass, though, we have added 3½ pounds more copper, so that instead of 6¾ pounds of brass we should use about 7¾ pounds, to make things right, and increase the tin and lead a scant ¼ pound. In order to get these into the crucible, we must cut the scrap content to 70 pounds. This mixture will

therefore read: Copper, 36 pounds; tin, 2½ pounds; lead, 2½ pounds; yellow brass, 7¾ pounds; scrap, 70 pounds.

While this is a good ordinary mixture, it is given more by way of illustration than as a formula. It can be cheapened considerably by using pewter instead of tin, and yet further by reducing the tin or pewter one-half and doubling the lead. Even at this latter stage it is a good metal to use in all small castings that have to be rapidly machined, as it works well under the tool.

Perhaps a few remarks about pewter would not be out of place at this stage. Although this scrap is called "pewter," it will, if it is of good quality, mostly consist of Britannia ware, the silver-plated articles so familiar in our homes. Their composition is mostly tin, with antimony and a little copper. The scrap on arrival should be carefully picked over, and all foreign metals weighed back. The cruet-stands always have an iron screw in the stem, and fruit-dish handles are generally brass. Get a file and try the suspected articles. If the file cuts easily, the metal is Britannia or pewter; if not, try it with the magnet, and if not iron, it is either zinc or German silver; or if the article is small, it may be real silver. If it is zinc or German silver, you don't want it; if zinc, because you cannot afford to buy it at the price of pewter, and unless you are using German silver in your business, it is worth no more than yellow brass to you, in the quantities in which it is found in pewter. If it is real silver, it will be stamped sterling somewhere, will not turn green where touched with nitric acid, and is worth 48 cents an ounce. Having sorted the pewter, the best thing is to run it down into small ingots, and also to make some little cakes, for make-weights, by pouring it on the floor. By thus melting it down we get our "tin" uniform, as the real pewter contains lead; we need make no allowance for this in our mixture, however.

The hard scrap, that we first picked out, we have taken no notice of so far. If we make a considerable quantity of hard bronze castings we can use this scrap in the manner just suggested for soft metal, using of course the regular hard formula for the new metal added, instead of the one we have been considering. Where there is no call for hard bronze, this kind of scrap may be used as "mixing" in the place of tin or pewter, the same as yellow brass is used in place of zinc. For driving brasses (these are the large semicircular brasses used on the axles of locomotive driving wheels) we may figure that 7 pounds of metal carry 1 pound of tin; thus we add 6 pounds of extra copper to every pound of tin. The zinc and lead content we do not need to notice. In rod brasses 8 pounds of metal average 1 pound of tin, while heavy bells carry a pound of tin in every 5 pounds of metal. A little figuring will show how to use these metals to advantage, along the lines laid down. As bells, however, seldom contain any lead, and only just enough zinc to provide against porosity, we must add sufficient of these metals to alloy the additional copper. Where hard castings are occasionally called for, and the customer expects to get them at the same figure as his softer castings (as is often the case), we can save this scrap for use on such occasions. Work in phosphor bronze will also occasionally come in, and be expected at a low figure; in such cases our assorted hard scrap is a money-saver. Melt it, and to every 100 pounds add 2½ ounces of phosphorus, just before pouring.

The chief drawback to the use of scrap is found in the fact that every piece is more or less oxidized; and when the metal is melted it contains considerably more oxide of copper than is good for it. Phosphorus is a good deoxidizer. Manganese may be used, so may silicon and aluminum; but the latter is not recommended here, as it is a bigger enemy to the brass founder than iron. A piece of phosphorus, ½ inch in length added to every pot of metal improves it considerably. Fluxes also are used to eliminate the oxide and other impurities. A refining flux is composed of equal parts crude tartar and nitre burned together. Stir into the metal a couple of pieces of this of the size of a walnut before pouring.

Another flux is composed of 1 part crude carbonate soda, 2 parts anthracite coal (pulverized) and 1 part salt, mixed; a couple of handfuls are thrown in while the metal is melting. The following mixture for improving alloys was the subject of a patent: Iron peroxide, 33 parts; manganese peroxide, 1 part; magnesium carbonate, ½ part; alumina, 18 parts; silica, 3½ parts; sodium bi-borate, 4 parts. Mix and stir well into the metal.

The consideration of yellow brass, scrap copper and the utilization of turnings and borings, sweepings, skimmings and grindings, may form the subject of another article in the near future.

American Machinery in Germany.

A leading German contemporary in a recent issue published an interesting editorial on the subject "American Machinery in Germany," from which we abstract the following:

"The importation of many classes of tools, implements and machines from the United States has increased during the last few years to such an extent that it now surpasses the imports of these articles from any other country of the world, even those of Great Britain. This is especially the case in those articles which, according to our present tariff, are subject to an import duty of 15 marks per 100 kilograms [$3.57 per 220 pounds]. Thus, for instance, during the first six months of the present year there were imported into the German Empire: 2,309 double centners [1 double or metric centner equals 220.46 pounds] machine knives, of which 1,609 d. c. came from the United States; the importation of scissors, shears and cutting tools amounted to 1,114 d. c., of which 473 d. c. were of American origin; other iron tools were imported to the amount of 2,275 d. c., of which 765 d. c. came from America. Imports of fine cast-iron goods amounted to 3,471 d. c., of which 1,809 were of American origin. Hand sewing machines, 9,061 d. c., of which 7,865 d. c. were from the United States; bicycles and parts thereof, 2,682 d. c., of which 896 d. c. came from America; typewriters, 299 d. c., of which 224 d. c. were of American origin; wrought-iron pipes and tubes, 121,-134 d. c., of which 50,980 were from the United States; polished, varnished or tinned iron ware, 27,617 d. c., of which 6,210 d. c. were of American origin; agricultural machinery, 217,063 d. c., of which 165,241 d. c. came from the United States; machine tools, 39,166 d. c., of which 29,378 d. c. came from the United States; lifting machines and elevators, 10,549 d. c., of which 5,240 were from the United States; machinery for the manufacture of wood pulp and paper, 2,014 d. c., of which 349 d. c. came from the United States; electrical machinery, 17,143 d. c., of which 1,950 d. c. came from the United States; milling machinery, 6,910 d. c., of which 1,568 d. c. were of American origin; sewing machines with stands, 19,957 d. c., of which 3,882 d. c. came from the United States; locomotives and portable engines, 22,749 d. c., of which 1,075 d. c. were from the United States; other industrial machinery, 88,815 d. c., of which 15,631 came from America.

"The immense increase in the total imports of machinery and iron and steel goods, which is chiefly due to the formidable and powerful competition of the United States, is best illustrated by the fact that the value of the importation of machinery, tools, implements, instruments, vehicles, iron and iron goods into the German Zollverein during the first six months of 1900 increased to 115,400,000 marks, as against 87,100,000 during the same period of 1899, and only 59,800,000 marks during the first six months of the year 1898. That is to say that within the short period of two years the imports have *almost doubled*, and this chiefly on account of the increasing imports from the United States, for the importation from all other countries has either been stationary or decreasing. It is well appreciated on the German market that many branches of the German iron and machinery industry are suffering from this heavy American competition, which is mainly due to *the absurdly low German tariff*. Under these circumstances, is not the present the time to modify our tariff, especially in view of the high protective duty the American Government levies on almost all German goods? On the other hand, there is little doubt that, if the Washington authorities do not become convinced that 'reciprocity' is a *con-*

ditio sine qua non in the long run for the maintenance and development of international commercial intercourse, other countries will be compelled to build protective barriers on the same lines as those now existing in the United States."

Letters from Practical Men

Rig for Hanging an Incandescent Lamp.

Editor American Machinist:

The rig described below allows the lamp to be shifted over a considerable area, and automatically holds it wherever it may be placed. Refering to Fig. 1, which is a plan showing the general arrangement, a piece of heavy fish line leads from the hook *A*, over the pulley *B*, and back to the hook C. The spring clip clothes-pin *D* travels on the fish line, the latter passing through two holes and a screw-eye in the pin, as shown in Fig. 2. After the clothes-pin is in place, the ends of the line are permanently tied to their respective hooks, the line being left somewhat slack. Suspended in this way, the lamp may be moved to any point within the imaginary triangle *A B C*, Fig. 1. The cord is indicated for two positions of the lamp by the solid and dotted lines, respectively. The nearer the lamp is moved to the pulley *B*, the more sag there will be to the line, and to neutralize this effect the pulley must be higher than the hooks. The latter should be no higher than is necessary to give head-room under the cord, while in a room of ordinary hight the pulley may be in or near the ceiling. Naturally the exact position of the hooks and of the pulley will in most cases depend upon the location of a convenient door or window, and considerable latitude may be allowed in placing them if care is taken to have the entire table, or other surface to be lighted, fall within the triangle *A B C* previously referred to. The hight of the lamp when located may of course be changed by slipping the leader wires through the clothes-pin.

New York. EDGAR H. BERRY.

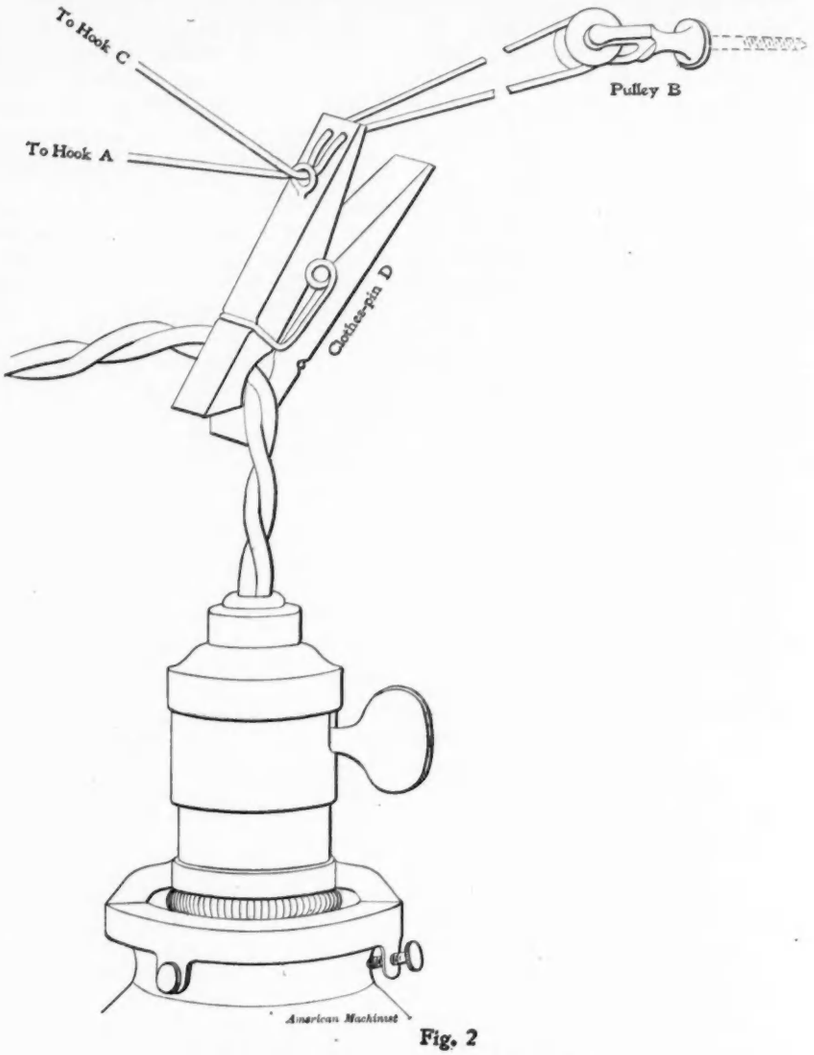


Fig. 2

RIG FOR HANGING AN INCANDESCENT LAMP.

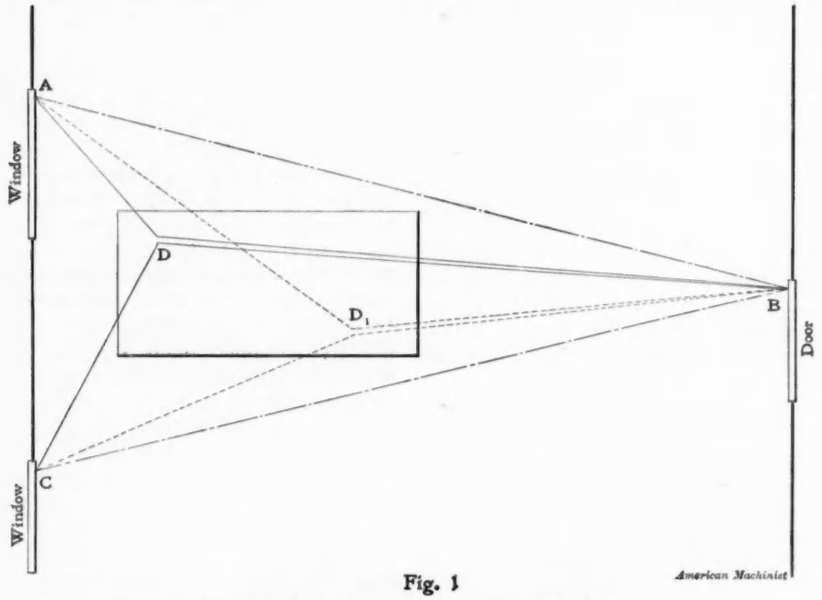


Fig. 1

THE RANGE OF SUSPENSION FOR THE LAMP.

A Traction Dynamometer.

Editor American Machinist:

The accompanying sketch shows an improved form of traction dynamometer which will no doubt be new to the greater portion of your readers.

The principal points of interest about this machine are its lightness (a machine of 10,000 pounds capacity weighing less than 12 pounds) and its simplicity, with the consequent cheapness. It might be well to add, however, that there is no company that is putting them on the market, the one at hand being the only one that has been made.

It will be seen from the sketch that it is of such a form as to easily permit its being adapted to any place where a traction dynamometer is needed. In the special case for which this one was made, it was required to measure the varying tractive power of a team of horses at work in pulling a constantly varying load, and the best machine offered upon the market was one of from 100 to 2,000 pounds capacity, which weighed fully 150 pounds, totally unsuiting it to the work in hand.

Referring to the sketch, it will be seen

that this dynamometer consists primarily of a circular spring having three points for attaching it to the source of power and the load, according to their magnitude.

In the position shown, the links are arranged for the lighter loads such as those for which it was designed, and in which position the machine is the most sensitive, reading to 1,500 pounds by increments of 50 pounds, smaller estimated, on the inner circle of graduations. In the intermediate position of the clevices the corresponding circle of graduations gives the load in 150 pound increments to 3,000 pounds, while in the extreme lower position the outer circle reads to 10,000 pounds by 250-pound increments.

The figure shows plainly the method of attaching the index, which carries a pencil point at *A*, for making a continuous record on a strip of paper kept moving past it, through the slots in the dial plate shown at *B*, by clockwork on the other side of the dial. The clockwork is not shown, on account of complicating the drawing, but the case which encloses it, as also the starting and stopping lever *C*, are shown in the side view. In this view the clevices and draft links are left out to more clearly show the safety link *E* that protects the spring from overload, and also to show the method of locking the front and back hinged covers together, the front one being provided with two glass-covered openings to enable the operator to read the load at any time.

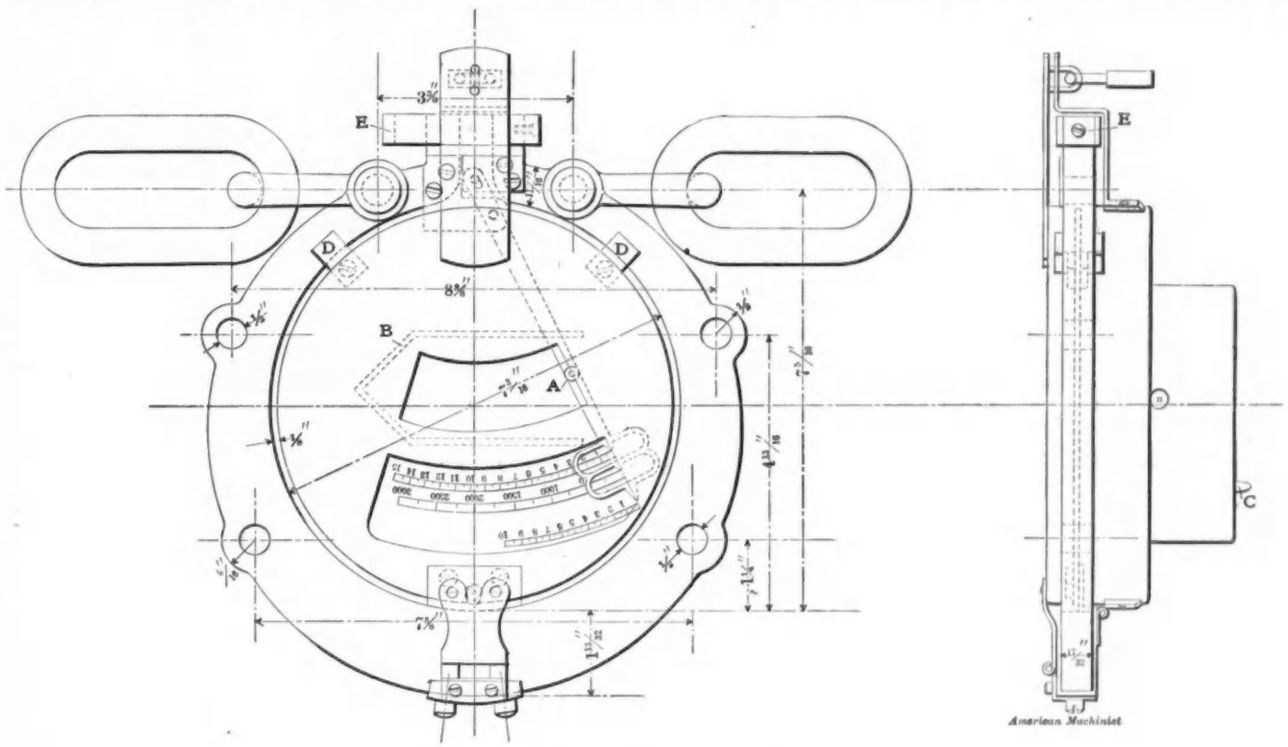
It will be noticed that the only point of attachment of the dial and hinged covers is at the neutral point of the spring as regards deflection, where they are not affected by its distortion under load. The alining clips *D D* allow a free movement of the spring ends between them.

This machine, as shown, is the invention of Mr. T. Lennox, the instructor in the college machine shops, where it was made. As but one was required, the hinged covers were formed by hand from sheet steel and then finished and blued. The dial was made from sheet brass and graduated under actual load in a 100,000-pound Riehle testing machine. The clevices and pins were made from tool steel, and, like the covers, blued to prevent rust.

G. F. DODGE.

Iowa State College, Ames, Iowa.

[We consider this an elegant piece of designing. The graduations on the dial do not correspond to the increments given in the text, but this, we presume, is a draftsman's error.—Ed.]



A TRACTION DYNAMOMETER.

Nonproductive Labor.

Editor American Machinist:

If there's a fellow to-day that deserves to be kicked (and there are several), it is he that brought into use the word "nonproductive" as applied to certain classes of labor connected with a manufacturing establishment and considered necessary to its profitable operation. The misleading practice, however, has been going on so long that the originator of it is probably dead, so that kicking will do him no good. There never was any justification for the employment of the word in the classification of employees. The objection to the word is that it is always an untruth; it conveys a wrong impression to begin with, it puts lots of faithful, hardworking and very necessary fellows in a false position, and it can't help but make trouble in more ways than one.

The worst trouble of course is with the business office. The wiseacres sit there and go over the weekly or monthly reports from the factory, and they are continually chagrined at the big ratio of the nonproductive to the productive labor. They never let up in their poking of the manager to cut down the nonproductive side of the sheet. It was the pride of the old-fashioned shop that it had so little nonproductive labor. Where all the work turned out by the shop was done and paid for by the day there were mighty few whose time couldn't be charged to the customers. It's so different now. The present use of the word nonproductive makes things look as if we had been progressing backwards; but we haven't. We have been going decidedly the other way. Things may go on with machine builders until the shops run like roller flouring mills. I went through one of those most perfectly organized institutions once, where they were making 400 barrels of flour a day. The wheat was taken off the cars, went through all the processes of the mill and got safely barreled and placed on other cars on the other side of the mill, and there were but eight men employed in the whole establishment, including clerk, engineer and all. There was no what you might call work being done by anybody. There were two or three men that I saw stepping around and seeing things go, and incidentally, I suppose, seeing that they went right; but I don't believe there was

any of what you might call "productive" labor in the entire building. The report of the mill, if made up like that of an up-to-date machine works, would have contained no record of any labor but "nonproductive" labor. But we will never get a machine works in that condition, because the business office will become a lunatic asylum first.

The simple and indisputable fact is that the so-called nonproductive labor of the shop is the most productive of all, and many shops are suffering because there is not more of it in them. The idea, in these days, of estimating the success of the management of a manufacturing establishment by the small proportion of nonproductive labor in it is an absurd one.

Let's see. Say we have a complete modern machine works of considerable size, with iron foundry, brass foundry, blacksmith shop, machine shop, boiler shop, pattern shop and carpenter shop. It is easy enough to divide the labor as far as one side of it goes, and the other side of course includes all the rest. The productive labor embraces all the fellows that do the work, both journeymen and apprentices. There will be the molders (including core makers), blacksmiths (including their helpers), machinists, boiler makers, carpenters and patternmakers. These will sometimes be doing "nonproductive" work, repairs, alterations and other shop work, and there may be some question as to the status of all the work of the patternmakers, but we will let that go.

The nonproducers will include a general manager, a superintendent, with their assistants; a purchasing agent, stenographers and typewriters, clerks of various calibre according to the magnitude of the works and the intricacy of the organization; cost clerks, time clerks, piece-work clerks, shipping clerks, a head draftsman, other draftsmen, tracers, blueprinters, photographer, foremen of the various shops, including foreman of the tool room, tool makers, errand boys, firemen, engineers (including the looking after the electrical and compressed-air service), painters, packers and shippers, stock-room men, traveling-crane men, general laborers or helpers, sweepers, teamsters, watchmen and gatemen.

They may not have all these everywhere, but I have in mind establishments that include all of them. This makes a pretty formidable list of nonproducers. But stop all the nonproducers and the production stops at once. Production depends on them; then why are they not producers?

Well, but if we can't get along without them, we can certainly get along without some of them. Here we have 1,200 hands all told, and there are fifty errand boys. Now, that's certainly absurd. What in time can all that flock of boys be doing all the while? They must be loafing most of the time, and we must be paying them for the loafing, or we must be promoting their demoralization. Now, it is on the record that those boys answer 2,500 calls a day, which is fifty for each boy, or twelve minutes for each call, if there is not a single minute wasted in the ten hours. The boys start from the tool room, and if it is a tool to be carried or exchanged it means two trips every time—first, to get the tool to be exchanged or to find what is wanted, and then to carry it to the man. Those are the simplest cases, and then there are others that involve more travel. The boys are called for any messages or light carrying from one shop to another, and from the extent of the works they can often have to walk half a mile for the completion of the one errand. The boy's time at, say, 50 cents a day almost invariably saves the same or a greater amount of time of a man at from $2.50 a day upward. On each trip the boy takes the place of a producer and does what under the old *regime* would be the producer's work; why then call him a nonproducer? The boy gets tired enough by the time night comes, and he doesn't get tired for nothing. We might follow up some of the more expensive "nonproducers" and make out just as good a case for them, but it is not necessary. While they may not each so clearly take the place of the producer and actually do his work, they may have a still more profitable function in superseding his work or in making his work accomplish or produce more.

This talk is not at all—or at least I don't mean it to be—an unprofitable quibble about the correct or incorrect use of a word, but has to do with a fact. It is a fact that the heads of manufacturing companies in the exercise of their wisdom do critically examine the relative ratios of so-called nonproductive and of productive labor, and that their approval or disapproval fluctuates with the ratio. I personally have heard the president of a large manufacturing concern express his satisfaction at the reduction of the nonproductive ratio in a report which he held in his hand. He simply didn't know what he was talking about. The production of various articles at his factory could have been at that moment cheapened by the employment of a lot of "nonproductive" labor in the tool room on jigs and special tools for the work, but he would have been the first and the hardest and most persistent kicker.

I certainly am not going to try to suggest some more correct words to use, such as indirectly productive and directly productive. The idea behind the words is wrong, and it will be better to drop the whole business. Let those who are most interested financially only, look at the two ends and not bother their heads about what lies between. If the total value of the product for a considerable period compares favorably with the total expense for the same time, they needn't worry, and it will be best not to scold.

TECUMSEH SWIFT.

A Specification for a Tap.

Editor American Machinist:

The accompanying sketch illustrates a wooden model of a tap, and shows how one man saved himself the trouble of making a drawing. He sawed off this stick of wood, and, after pasting on a few directions, sent it along with a request for a quotation on a *real* tap to model. If the

A SPECIFICATION FOR A TAP.

reader will commence at the proper end, "read this first and follow up," he will get a very good idea of what was wanted. The somewhat important matters of diameter and pitch of thread are not given on the model, but were, however, mentioned in the letter accompanying the same. The letter also stated the importance of making the tap to the exact length of the

model. As the latter was cut off at such an angle that one side was fully ¼ inch longer than the opposite side, it practically formed its own limit gage, a measurement at the shortest point being too short, at the longest point too long, and anywhere between, just right. Some good points in the art of spelling and in capitalization will be noticed by the reader. The writer is keeping this club, which is several sizes larger than the sketch, until such time as he may join the local police force.

F. A. STANLEY.

New Catalogs.

The International Correspondence Schools, Scranton, Pa., send us a pamphlet explaining their courses of study in electric power and lighting, electric lighting and electric railways. Size, standard, 6x9 inches.

"Object Lessons in Vertical Milling Machine Practice" is a little pamphlet ready for distribution by the Becker-Brainard Milling Machine Company, Hyde Park, Mass. In it is a series of illustrations showing how the vertical spindle miller does a good many different kinds of work, of which the first given is, "finishing spots on inside surface of feed-bracket casting with an end mill, same cutter also finishing upper end of casting; economy over counterboring, 10 to 1." The pamphlet is of standard size, 3½x6 inches.

The Betts Machine Company, Wilmington, Del., sends us a catalog of its improved planing machines. These are concisely described and are shown in illustrations printed on highly finished paper. They range from the 36-inch to the 120-inch planer. Frog and switch planing machines from 36 to 60-inch are also listed, and there is a view of an electrically driven 96-inch planing machine as arranged for the New York Ship Building Company, Camden, N. J., showing the electric drive and the three-speed countershaft. Size, 6¾x9¾ inches.

We have received from the Lodge & Shipley Machine Tool Company, Cincinnati, O., its latest catalog, "H," of lathes and attachments. The engine lathes here shown run up to a 42-inch improved triple-geared machine, also built to swing 48 inches. There are also illustrated a turret to go on the carriage of improved engine lathes, a 22-inch turret chucking engine lathe, a 24-inch "Oregon" turret lathe, a rise and fall rest, variable speed countershaft, improved taper attachment, European compound rest, chucks, etc. A table of code words is appended. Standard size, 6x9 inches.

The newest catalog of the Keuffel & Esser Company, 127 Fulton street, New York, describes almost everything imaginable in the way of drawing materials and surveying instruments. It has 482 pages, which is over fifty more than the company's last catalog contained. Among the more important changes are the following: Fuller descriptive matter, many improved and additional cuts, a greater listed assortment of slide rules, planimeters, pantographs, narrow steel tapes, drawing instruments, scales, drawing tables, etc. Profile and cross-section rulings on cloth have been added. Size 5¾x8¾ inches.

The Baldwin Locomotive Works (Burnham, Williams & Co.), Philadelphia, Pa., send us a book modestly entitled "Illustrated Catalogue of Narrow-Gauge Locomotives." The first ninety pages are devoted to an interesting history of the works, which date back to 1831 as a locomotive-building concern. This account is illustrated with vignette cuts of successive types of engines introduced. Following is a treatise upon a system of narrow-gage locomotives, with illustrations of the different styles, tables of dimensions, code words and general information. Beyond this are printed eighty full-page line plates of locomotive details, fittings, etc. Altogether, the book contains 452 6x9-inch (standard size) pages, and it is bound in cloth.

Manufacturers.

The Pottstown (Pa.) Manufacturing Company will enlarge its plant.

The plant of the Russia Cement Company, Gloucester, Mass., is being enlarged.

The Waters Pierce Oil Company, St. Louis, Mo., will put up a mill at Ola, Ark.

The new Tuscarora Rubber Company, Beach City, O., has started to build a factory.

The F. B. Peck Axe Manufacturing Company will erect a new factory at Cohoes, N. Y.

(*Continued on page* 44.)

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Gear Wheels, gear cutting. Grant; see p. 22.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Forming lathes. Mer.Mach.T.Co.,Meriden,Ct.

Punches & dies. Wal.M.Wks.,Waltham,Mass.

Gas engine castings. Box 181, Springfield, Mass.

For Sale—4 H.-P. and 2 H.-P. gas engines. Box 1171, Springfield, Mass.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Book "Dies and Diemaking," $1, post paid. J.L.Lucas,Bridgeport,Ct. Send for index sheet.

F. J. Stokes Machine Co., 13th and Noble sts., Philadelphia, Pa., build light machinery.

Model, experimental and fine tool work. Pollard Alling Mfg. Co., 35-37 E. 20th st., New York City.

Selden Packing for Stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., New York.

Threads and gears; easy rules to cut any thread possible to be cut in the lathe, without algebra, sent to any address for 25c. (postal order) by G. W. Dixon, Spring Lake, Mich.

Wanted—To exchange a 25 H.-P. upright high-speed steam engine, good order, for a gasoline engine 2½ to 8 H.-P.; 5 H.-P. Otto preferred. A. L. Lockwood, Gardner, Mass.

Wanted—A middle-aged man, familiar with the foundry and machine business, with some capital; a good opportunity for the proper man. Address Box 24, AMERICAN MACHINIST.

Institutions retiring from business having machine tools, brass and wood working machinery will find it to their interest to correspond with us. We purchase complete plants or handle them on com. C. C. Wormer Mach. Co., 55-59 Woodbridge st., W., Detroit, Mich.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents.

CUTTING OFF MACHINES, THE LATEST AND BEST.
HURLBUT ROGERS MACHINE CO.
SO. SUDBURY, MASS.
German Agents: Schuchardt & Schutte, Berlin and Vienna.
English Agents: Chas. Churchill & Co., Ltd., London and Birmingham.

Situations Wanted.

Mechanical draftsman, now employed, wishes to change. Box 25, AMER. MACH.

Draftsman wants position; paper machinery preferred. Address 202 B, care A. MACH.

Draftsman; 5 years' experience as assistant to M. E.; also practical machinist. Box 31, AMERICAN MACHINIST.

A young practical mechanical engineer, with extensive experience, wishes position with large manufacturing company. Box 26, A. M.

Practical mechanical engineer, with 3 years' experience in drawing room, desires change; technical education; age 26. Box 27, AM. M.

Expert in designing and testing pumping machinery and air compressor desires situation in New York. Box 4, AMER. MACHINIST.

Position as machine-shop foreman; well up in all matters appertaining to economical shop management; very best references. Box 32, AMERICAN MACHINIST.

Wanted—Position as designer on special machinery; 15 years' experience; best references; preferably New England. Address Box 35, AMERICAN MACHINIST.

A first-class general foreman wishes to make a change; can handle 100 to 150 men. If you want a good foreman for a machine shop please address Box 33, AMER. MACH.

A practical foreman and superintendent, with 25 years' experience in engines, dynamos and general machine-shop work, desirous of position. Address Box 34, AMER. MACH.

Mechanical engineer with years of practical experience in steam plant, mill construction and crushing-plant machinery; a position of responsibility is solicited. S. C., AM. M.

Glasgow Exhibition.—Mechanical engineer, acquainted with British and continental machine trade, good address, speaks five languages, is in a position to take charge of additional exhibits at low terms; first-class references and security if desired. Box 30, AMERICAN MACHINIST.

Practical mechanic, experienced in interchangeable manufacturing, open for engagement; familiar with latest methods for reducing costs and expert designer of special tools and fixtures; superintendent or assistant on work similar to cash registers, typewriters, etc. Box 28, AMERICAN MACHINIST.

Practical superintendent with technical education, capable of organizing or reorganizing a machine plant according to the very latest methods, aggressive, and plenty of executive ability in carrying out plans, at present in charge of 350 men on engines, pumps and all kinds of power-plant machinery, will be open for engagement December 1. Parties requiring a general superintendent, please address Box 29, AMER. MACHINIST.

Superintendent wishes to make a change; would like to get into a good, up-to-date factory where ability rather than talk would be appreciated; have had 20 years' practical experience on automatic machinery, tools, punches and dies, both open and sub-press dies, on the interchangeable system; good organizer and disciplinarian; inventive abilities and designer; correspondence solicited from good, reliable firms. Address "Exactitude," care AMERICAN MACHINIST.

Help Wanted.

Wanted—Experienced machine tool draftsman; state experience, age and salary expected. Address H. W. B., care AM. MACH.

Wanted—Several mechanical draftsmen. Address C. M. H., care AMERICAN MACHINIST, giving references, experience and salary expected.

Wanted—A first-class drop-hammer die sinker; steady work; good wages. United Shoe Machinery Co., McKay Dept.; Factory, Winchester, Mass.

Wanted—A young man for drafting and designing; thorough knowledge of gas engines essential. Address, stating experience, "Alpha," care AMERICAN MACHINIST.

Wanted—A competent and practical designer on sheet metal tools and special machinery. Address, with all particulars, "Sheet Metal," care AMERICAN MACHINIST.

Superintendent wanted for a machine shop and foundry employing 60 men; work is general machinery and repairing. Address, with references, Morris County Machine & Iron Co., Dover, N. J.

Wanted—A strictly first-class mechanical and steam engineer of tested ability and experience, thoroughly up in his profession; substantial salary and permanent position. Address, confidentially, Box 21, AM. MACH.

Wanted—An expert shop cost accountant,

(*Continued on page* 44.)

(*Continued from page 43.*)

The Weatherly Foundry & Machine Company, Weatherly, Pa., will extend its works.

New machines are to be put in at the plant of the Aiken Canning Company, Brunswick, Ga.

A $100,000 cotton mill is projected at Hope, Ark. One of those interested is Capt. Bridewell.

The Garland Chain Company, Rankin, Pa., is in the market for a number of rivet machines.

The No Treadle Sewing Machine Company will erect a plant at Huntsville, Ala., to cost $100,000.

The Hood Rubber Company, Boston, Mass., will erect an addition to its plant at Watertown, Mass.

The McCaffrey File Company, North Fifth and Berks streets, Philadelphia, Pa., will build an addition.

It is expected that Jennings Bros., Lopez, Pa., will erect a large lumber plant in the early spring.

The Erie (Shingle) Mill Company, whose plant at Blaine, Wash., was recently burned, will rebuild soon.

The Pennsylvania Railroad is said to intend removing its repair shops from Cambridge and Crestline to Toledo, O.

The Cohansey Glass Manufacturing Company, Bridgeton, N. J., is removing its business to Downingtown, Pa.

The Butler Novelty Company, Butler, O., is having an addition built to its plant, which will be used for an engine-room.

A building permit has been granted to the Cleveland Hardware Company, Lake street, Cleveland, O., for a $40,000 factory.

The Varley Duplex Magnet Company, of Jersey City, N. J., is negotiating with a view to locating a factory at Kenosha, Wis.

The American Axe & Tool Company has, it is said, decided to nearly double the size of the plant being erected at Glassport, Pa.

A large compound pump for water-works service will be purchased by the treasurer of the National Military Home, Dayton, O.

A new factory building is to be erected on Iranistan avenue, Bridgeport, Conn., for N. Palmer & Co., manufacturers of leather belting.

Beckman Bros., pump manufacturers, Des Moines, Ia., are to erect another building for their factory plant at East Fifth and Raccoon streets.

The Semet-Solvay Company is doubling the capacity of its bi-product plant at Ensley, Ala. It is understood that about $500,000 will be expended.

The Inter-State Foundry Company, of Cleveland, O., has been granted a charter to carry on a general foundry trade. The capital stock is $400,000.

A permit has been granted for the Atlanta Knitting Mill, which manufactures underwear, to erect a $5,000 building on Wells and Bluff streets, Atlanta, Ga.

A building permit has been issued for a $35,000 factory of the Sherwin-Williams Company, manufacturer of paints and colors, on Lime street, Cleveland, O.

The leach house and pump house of the Eagle Valley tannery, owned by the Elk Tanning Company, Ridgway, Pa., were recently burned, but are being rebuilt.

The Pittsburgh Plate Glass Company has applied for permission to erect a six-story brick factory at Court street and Broadway, Cincinnati, O., to cost $60,000.

The American Agricultural Chemical Com-

(*Continued on page 45.*)

Help Wanted—Continued.

to organize new system in foundry and machine shop; must come well recommended and have good record; state age and experience in application. Address "Gears," care AM. M.

Machinists—Three or four first-class men, competent and familiar with erecting work, particularly steam engines and pumping machinery. Address, with full particulars, giving reference and salary desired, P. O. Box 2762, New York.

We are enlarging our works, and will shortly require an increased number of skilled mechanics; we invite application from pattern makers, molders and machinists. Address the Westinghouse Machine Company, East Pittsburgh, Pa.

Wanted—Foreman for foundry employing 40 to 60 molders, making engine and boiler castings; married man preferred; state age, last employer and wages expected; A1 position for right man. Address "Jones," care AMERICAN MACHINIST.

A shop making 300 small automatic cut-off engines a year is looking for a superintendent capable of taking full charge of the manufacturing, with a view of increasing their output and sizes; a good opportunity for an up-to-date man. Address Box 366, AMER. MACH.

Wanted—Superintendent of machine shop employing 50 men; man having knowledge of electric work preferred. Address Box 23, AMERICAN MACHINIST, stating experience in handling men, devising means for getting out work quickly, giving references and salary wanted.

Wanted—25 good vise hands on light machine work; only good, steady men need apply; to such, good pay and permanent positions are offered; state age, wages now received, where you have been employed, whether single or married. American Machine & Foundry Co., Hanover, Pa.

Wanted—Erecting superintendent for shop in New England, for vertical and horizontal engines, compressors and pumps; one who is a first-class mechanic and a hustler, and with good experience and executive ability; who has had experience in the erection of Corliss engines and marine work; good pay to the right man. A 74, AMERICAN MACHINIST.

VANDERBEEK TOOL WORKS

Hartford, Conn., U.S.A.

Universal Joints

Run at 70° angle; solid stems, which can be turned or bored out close up to the ball circle; bearing contact on whole circumference; little friction; simple; strong.

PRICES: ¾″ **$1.50** each; 1″, **$2.00**; 1¼″, **$2.50**; 1½″, **$2.75**; 1¾″, **$3 00**; 2″, **$3.25**; 2½″, **$6.75** f.o.b. Hartford.

Beware of Imitations.

Accuracy

Continued Accuracy

ACCURACY MAINTAINED INDEFINITELY

are characteristics of

Shaw Mercury Gages

and Mercury Tank Indicators.

Pressures from 1 oz. to 50,000 lbs.

for Steam, Gas, Blast and Hydraulic Work.

Up-to-date Gage Boards fitted complete.

QUIMBY ENGINEERING CO.,

915 Ridge Avenue, PHILADELPHIA.

Jno. J. Cone. Robert W. Hunt. Jas. C. Hallsted.
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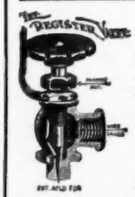
ROBERT W. HUNT & CO.,

BUREAU OF INSPECTION, TESTS AND CONSULTATION.

71 Broadway, New York. 1121 The Rookery, Chicago. Monongahela Bank Bldg, Pittsburgh.

Inspection of Rails and Fastenings, Cars, Locomotives, Pipe, etc. Bridges, Buildings and other Structures. Chemical and Physical Laboratories.

Reports and Estimates on Properties and Processes.



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For controlling the flow of gasoline or other fluids; stays where you put it and indicates the place.

Our Auto-Carburettor for Gasoline Engines is the best yet.

Send for booklet and prices.

THE AVERY & JENNESS CO.,

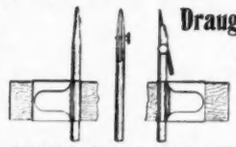
26 W. Washington St., CHICAGO, ILL.

A Smaller Size Combination Drill and Countersink.

We have recently got out a size suitable for centering work ¼″ in diameter and under.

This size is called H. Size of body 5-32″, of drill 3-64″.

J. T. SLOCOMB & CO., Providence, R.I., U.S.A.



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The Lightest, Simplest, Cheapest and Best Trammel Points ever produced. Made of German Silver and Stub Steel. Sent complete with beam, postpaid, for ONE DOLLAR in U. S.

Address,

PRECISION TRAMMEL WORKS,

No. 28 Brook St., Hartford, Conn.

It Costs One Cent

to lace a Five Inch Belt on this machine, and takes less than three minutes to do it. The lace is exactly alike and even with the surface of the belt on both sides.

The belt can be connected or disconnected in a few seconds—a worth-while point where belts of varying length are required, or where reverse belts are kept in readiness. And, mind you, our Coil Clasp Lacing will last three times as long as any other. The 6,000 inches given with each machine will lace as much belting as $75.00 worth of lace leather, nearly paying the cost of the machine in lacing alone. If you'll send for our circular and read it, you'll "swear off" on skiving and glueing belts.

Diamond Drill & Machine Company

BIRDSBORO, PA., U. S. A.